73 Amateur Radio Today

Including Ham Radio Fun!

MAY 1998
ISSUE #452
USA $3.95
CANADA $4.95

International Edition

2 El. Fox Hunter

El Cheapo 20m Unbeam

Rx Sensitivity Booster

Weather Rx Interface

What's this DDS Stuff?

**********5-DIGIT 48103
#0000019198IWR9# JUN76
UNIV MICROFILM
SERIAL PRCNG ATTNL
300 N ZEEB RD
ANN ARBOR MI 48103-1553

Review:

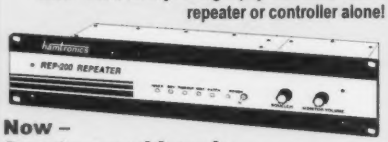
GMSK 57.6k Packet Modem

0 74851 08725 1

Get more features for your dollar with our

REP-200 REPEATER

A microprocessor-controlled repeater with full auto-patch and many versatile dtmf remote control features at less than you might pay for a bare bones repeater or controller alone!



Now –
2 meter machines in stock for next day shipment!

- ***kit still only $1095***
- ***factory assembled still only $1295***

50-54, 143-174, 213-233, 420-475 MHz. (902-928 MHz slightly higher.)
☛ **FCC type accepted** for commercial service in 150 & 450 MHz bands.

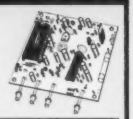
Digital Voice Recorder Option. Allows message up to 20 sec. to be remotely recorded off the air. Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!** .....only $100.

REP-200C Economy Repeater. Real-voice ID, no dtmf or autopatch. ..... Kit only $795, w&t $1195.

REP-200N Repeater. Without controller so you can use your own. ..... Kit only $695, w&t $995.

You'll KICK Yourself If You Build a Repeater

Without Checking Out Our Catalog First!



Hamtronics has the world's most complete line of modules for making repeaters. In addition to exciters, pa's, and receivers, we offer the following controllers.

COR-3. Inexpensive, flexible COR module with timers, courtesy beep, audio mixer. ..... **only $49/kit, $79 w/t.**

CWID. Traditional diode matrix ID'er. ..... **kit only $59.**

CWID-2. Eprom-controlled ID'er. ..... **only $54/kit, $79 w/t.**

DVR-1. Record your own voice up to 20 sec. For voice id or playing club announcements. .....**$59/kit, $99 w/t.**

COR-4. Complete COR and CWID all on one board. ID in eprom. Low power CMOS. ..... **only $99/kit, $149 w/t.**

COR-6. COR with real-voice id. Low power CMOS, non-volatile memory. .....**kit only $99, w/t only $149.**

COR-5. µP controller with autopatch, reverse ap, phone remote control, lots of DTMF control functions, all on one board, as used in REP-200 Repeater. .....**$379 w/t.**

AP-3. Repeater autopatch, reverse autopatch, phone line remote control. Use with TD-2. .....**kit $89.**

TD-2. Four-digit DTMF decoder/controller. Five latching on-off functions, toll call restrictor. .....**kit $79.**

TD-4. DTMF controller as above except one on-off function and no toll call restrictor. Can also use for selective calling; mute speaker until someone pages you. .....**kit $49.**

SUBAUDIBLE TONE ENCODER/DECODER

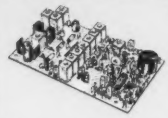
Access all your favorite closed repeaters!

- **Encodes** all standard CTCSS tones with crystal accuracy and convenient DIP switch selection.
- Comprehensive manual also shows how you can set up a front panel switch to select tones for several repeaters.
- Decoder can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver. **New low prices!**

- **TD-5** CTCSS Encoder/Decoder Kit .....now only **$29**
- **TD-5** CTCSS Encoder/Decoder Wired/tested **$49**

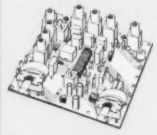
CRYSTAL CONTROLLED VHF & UHF FM EXCITERS & RECEIVERS

FM EXCITERS: 2W output, continuous duty.



- **TA51:** for 6M, 2M, 220 MHz .....kit $99, w/t $169.
- **TA451:** for 420-475 MHz. .....kit $99, w/t $169.
- **TA901:** for 902-928 MHz, (0.5W out) .....w/t $169.

VHF & UHF POWER AMPLIFIERS.
Output levels from 10W to 100W ..... **Starting at $99.**



FM RECEIVERS:

- **R100 VHF FM RCVR. Very sensitive** – 0.15µV. **Superb selectivity,** >100 dB down at ±12 kHz, best available anywhere, flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. ..... kit $129, w/t $189.
- **R144 RCVR.** Like R100, for 2M, with helical resonator in front end.....kit $159, w/t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to R100 above. .....kit $129, w/t $189.
- **R901 FM RCVR,** 902-928MHz .....$159, w/t $219.

WEATHER ALERT RECEIVER

A sensitive and selective professional grade receiver to monitor critical NOAA weather broadcasts. Good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios!

Automatic mode provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast. Crystal controlled for accuracy; **all 7 channels** (162.40 to 162.55).

Buy just the receiver pcb module in kit form or buy the kit with an attractive metal cabinet, AC power adapter, and built-in speaker. Also available factory wired and tested.

RWX Rcvr kit, PCB only **$79**
RWX Rcvr kit with cabinet, speaker, & AC adapter **$99**
RWX Rcvr wired/tested in cabinet with speaker & adapter **$139**

WEATHER FAX RECEIVER

Join the fun. Get striking images directly from the weather satellites!

A very sensitive wideband fm receiver **optimized for NOAA** APT & Russian Meteor **weather fax** on the 137MHz band.

Designed from the start for optimum satellite reception; not just an off-the-shelf scanner with a shorted-out IF filter!

Covers all 5 satellite channels. Scanner circuit & recorder control allow you to automatically capture signals as satellites pass overhead, even while away from home.

- **R139 Receiver Kit** less case **$159**
- **R139 Receiver Kit** with case and AC power adapter **$189**
- **R139 Receiver w/t** in case with AC power adapter ...**$239**
- Internal PC Demodulator Board & Imaging Software **$289**
- Turnstile Antenna **$119**
- Weather Satellite Handbook **$20**

WWV RECEIVER

Get time & frequency checks without buying multiband hf rcvr. Hear solar activity reports affecting radio propagation. **Very sensitive and selective** crystal controlled superhet, dedicated to listening to WWV on 10 MHz. Performance rivals the most expensive receivers.

- **RWWV Rcvr** kit, PCB only **$59**
- **RWWV Rcvr** kit with cabt, spkr, & 12Vdc adapter **$89**
- **RWWV Rcvr** w/t in cabt with spkr & adapter **$129**

SYNTHESIZED VHF FM EXCITER & RECEIVER MODULES

No more waiting for crystals!

NEW

Hamtronics is pleased to announce a new line of its vhf fm transmitters and receivers, popular for repeaters, voice & data links, control, telemetry, and other demanding applications.

T301 Exciter and R301 Receiver provide high quality nbfm and fsk operation on 144-148 MHz and 220-225 MHz (also 139-174 MHz and 216-226 MHz for export and gov't services). Features include:

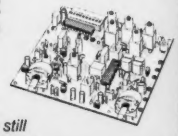
- *Dip switch frequency selection.*
- *Exceptional modulation for voice and ctcss.*
- *Very low noise synthesizer for repeater service.*
- *Direct fm for data up to 9600 baud.*
- *Commercial grade tcxo for tight frequency accuracy in wide range of environmental conditions.*
- *In stock for same day shipping.*

T301 EXCITER

Rated for continuous duty, 2-3W output.

- **Kit** (ham band only) ...$109
- TCXO option ...$40
- **Wired/tested** ...$189 (includes TCXO)

R301 RECEIVER



- **Kit** (ham band only) ...only $139
- TCXO option ...$40
- **Wired/tested** ...$209 (includes TCXO)
- Traditional crystal-controlled receivers & *exciters are still available for all vhf and uhf bands.*

LOW NOISE RECEIVER PREAMPS

LNG-( ) GaAs FET PREAMP

STILL ONLY $59, wired/tested

- Make your friends sick with envy! Work stations they don't even know are there.
- Install one at the antenna and overcome coax losses.
- *Available for 28-30, 46-56, 137-152, 152-172, 210-230, 400-470, and 800-960 MHz bands.*

LNW-( ) ECONOMY PREAMP

NOW ONLY $24/kit, $44/w&t

- Miniature MOSFET Preamp
- Solder terminals allow easy connection inside radios.
- *Available for 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, and 400-500 MHz bands.*

TRANSMITTING & RECEIVING CONVERTERS

No need to spend thousands on new transceivers for each band!

- Convert vhf and uhf signals to & from 10M.
- Even if you don't have a 10M rig, you can pick up very good used xmtrs & rcvrs for next to nothing.
- Receiving converters (shown above) available for various segments of 6M, 2M, 220, and 432 MHz.
- Rcvg Conv Kits from $49, wired/tested units only $99.

- Transmitting converters for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

Buy at low, factory-direct net prices and save!
For complete info, call or write for complete catalog.
Order by mail, fax, email, or phone (9-12, 1-5 eastern time).
Min. $6 S&H charge for 1" lb. plus add'l weight & insurance.
Use Visa, MC, Discover, check, or UPS C.O.D.

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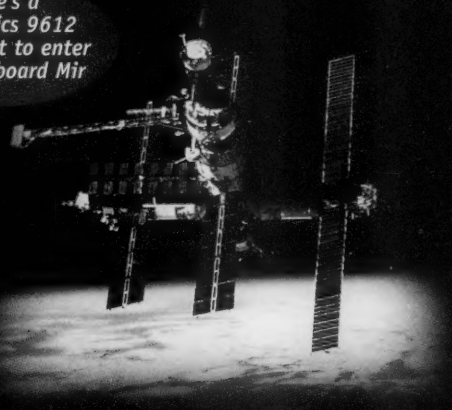
Phone 716-392-9430 (fax -9420)

on the Outernet!



There's a Kantronics 9612 Plus about to enter service aboard Mir

There's a world of digital communications fun and adventure that *only hams can enjoy* and Kantronics makes it possible for you to explore it. No matter if you call our products TNCs, wireless modems or digital controllers, the "Outernet™" offers a world of adventure, including satellite communications, APRS®, DX spotting, BBS operations, WEFAX, EMWIN, TCP/IP links, remote control and sensing, telemetry, HF e-mail with commercial service providers and more!

Commercial versions of Kantronics TNCs are being used in ever-increasing numbers!

antronics offers a number of ways to enjoy the growing field of igital communications. Choose the unit that suits your interests and udget. All Kantronics units come with a one-year limited warranty nd can be upgraded when firmware updates become available.

KPC-3 Plus

- 1200 bps - Now with more features!
- Packet, GPS/APRS, Host, KISS and WEFAX modes
- Personal Mailbox (PBBS) now supports multiple calls
- Copies NWS EMWIN with optional software
- Remote access, sensing and control with two A/D and two control lines
- KA-Node or option K-Net networking capability
- PBBS 100k, expandable with optional 512k RAM
- Uses external power or internal 9v battery
- NEWUSER mode and online help

8.2 Firmware now with Advanced GPS/APRS UI digipeating available for all 3 models!

KPC-9612 Plus

- 1200 port AND second port of 4800 ~ 38,400 bps
- Most modes/capabilities of the KPC-3 Plus and POCSAG (paging)
- Unique design allows the addition of *another port, high or low speed**
- KA-Node or K-Net option works with multiple ports
- Remote access, sensing and control capability
- Telemetry transmission capability
- NEWUSER mode and online help

KAM Plus

- Same great KAM Plus performance in an attractive new package!
- Dual port VHF/HF (1200/<=300 bps) multimode TNC
- Packet, GPS/APRS, Host, KISS, WEFAX, CW, RTTY, AMTOR, PACTOR, G-TOR™, TOR, and Free Signal Detection for HF e-mail
- 100k personal mailbox standard, expandable with optional 512k RAM
- Remote access capability
- Real time, battery backed clock
- NEWUSER mode and online help
- New style case available for older Kam Plus units

Kantronics

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web: www.kantronics.com

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ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SWITCHING POWER SUPPLIES

	CONT.	ICS	WT.(LBS)
SS-10	7	10	3.2
SS-12	10	12	3.4
SS-18	15	18	3.6
SS-25	20	25	4.2
SS-30	25	30	5.0

SS-25M With volt & amp meters
SS-30M With volt & amp meters

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

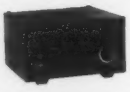
- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

- LOW PROFILE POWER SUPPLY

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

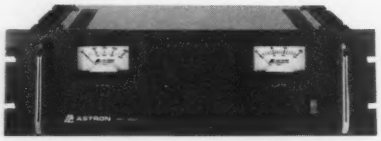
RS-L SERIES



- POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

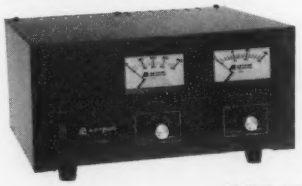
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES



MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amp to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	67	34	16	70	6 x 13¾ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE C

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Including Ham Radio Fun!

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HAM RADIO FUN SECTION

IK8VWA 64 Home-Brewing, Italian-Style!
A two-element phased beam for ARDF.

K5LAD 66 Ya Gotta Shop Around
Take your time, do your homework, and get the best deal!

On the cover: Captured on film by Joe Moell KØOV, this ammo-box fox first appeared in the pages of our March issue. You can find foxhunting fun every month in Joe's "Homing In" column.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

NEVER SAY DIE

Wayne Green W2NSD/1

New Licenses

In looking at the December 1997 FCC figures for new licenses issued as compared with December 1996, I see that the number of new no-code Tech licenses dropped 42% and the number of new General licenses dropped 41%. Just in one year! Does anyone have any ideas on why the interest in amateur radio seems to be dropping like a lead balloon?

Let me know when you think it's about time to start advertising and promoting our hobby. Better yet, let the League and your director know. I'm in a good position to wring my hands. They're in a good position to mount a PR blitz.

When was the last time you saw amateur radio portrayed favorably on TV or in the movies? If there have been any articles in any of the major magazines about how much fun the hobby is, how it makes it so one need never be lonely again, and how there are all sorts of adventures possible, you haven't sent me a clipping. Isn't there something in the ARRL charter about helping to preserve the hobby?

The League is supposed to do what the members want. If you are a member, you are voting with your membership payment, your buying of League books, and your patronizing (spending money with) the *QST* advertisers. You really *do* have a lot of clout, if you want to use it.

Morse Requiem

Darn, I've forgotten the name of the chap who really invented the International Continental Code. I'd put it down to getting old except that I've always had a lousy memory, and it's been a bunch of years since I've written about the subject. No, it wasn't Morse. Old Sam, who's gotten the credit, devised the code used by telegraphers with those sounding units. I had one around here, but some past editor stole it. Morse's code went clickety-clack, not dah-di-di-dah.

Well, no matter whose code the League is trying to preserve as a way to keep our numbers limited and make sure we have as little political clout as possible, the dratted stuff is slowly dying. Indeed the plug has been pulled by one service after another. In the 1980s, the International Marine Organization phased it out, replacing it with land- and satellite-based systems. All cargo ships of more than 300 tons will be required to comply with the new regulations by next year.

The US abandoned monitoring 500 kHz, the distress channel, five years ago. Canada dropped this service on the West Coast last year. On the East Coast, a few Coast Guard stations will monitor the channel until next year, just in case. French listening stations went QRT two years ago. Britain has also ended monitoring 500 kHz.

Most craft these days have an Emergency Position Indicating Radiobeacon which they can throw into the water and which will transmit their location via satellite. These signals are then relayed to other nearby ships. There are also search-and-rescue transponders which will show on ship's radar, helping find ships in time of distress.

Some sailors are using cell phones.

These days about the only place you'll hear the code being used is on a small segment of a few ham bands.

A recent survey of new hams showed that over 99% of them said they had no plans for using the code in the future. It is estimated that there are perhaps a couple thousand US old-timers who really enjoy CW and are using it on a regular basis for making ham contacts.

The League Slump

I didn't realize how much the League's position on maintaining the CW barrier was hurting their membership until I looked over their figures for 1996 vs. 1995 (it's still too soon for the 1997 figures). I was amazed to see that the membership dropped by almost 3% in just one year! And this while the number of hams grew by over 12,000. Only 2.9% of the Novices were League members. One would expect newcomers to the hobby would be almost 100% joining the League, anxious to learn more about hamming and deciding on the equipment they'll want to buy. One would be in total error.

A pathetic 15% of the Techs have bothered to join the League. And only 20% of the Generals. Obviously the League and *QST* are seen as either irrelevant or the enemy by almost 80% of licensed amateurs. Yet this is the group that says it is representing all of us.

This monumental failure on the part of the League to be relevant to today's hams tells us that the ARRL Board of Directors has failed in their responsibility to their constituents and the staff of *QST*. Someone needs to get in there and shake some sense into the directors and get them to take their responsibility seriously. Or perhaps sue them for malfeasance. And *QST*, which still remains a 1930s kind of magazine, needs some fresh blood, too. Other than the larger size, the magazine looks and feels about the same as it did 60 years ago, when I first joined the League in 1938. It has all the personality of an automatic dishwasher, but is not as up-to-date.

The same old contests, year after year, decade after decade, eon after eon. The same page after page of "membership news," which is of little interest to anyone. I've never bothered to read this section. It's a sterile, boring, self-serving magazine.

A note from Guy Matzinger W1GUY points out, complete with documentation, that it was the ARRL which, in 1936, got the FCC to increase the code speed from 10 wpm to 13 wpm, with the claimed intent being to limit the number of hams coming into the hobby, there being about 46,000 at that time. The bands were getting too crowded. The FCC went along with it because the military wanted as skilled a pool of trained CW operators as possible, in case of war.

Well, that made sense 60 years ago. Today, with more modern communications techniques making it so we have room for several million hams on our bands, and with the military having no more interest in us, it is numbers and numbers only that will keep the hobby afloat.

The recent articles on the FCC auctions make it very clear that our ham bands are in the queue for auctioning. With a dwindling number of hams using our HF bands, and with our average age creeping towards the Social Security check crowd, and with almost zero cultural diversity, either

the ARRL will have to come to its collective senses and wake up, or we're history.

Ham Fundamentalists

Good grief, it was 40 years ago at the ARRL Convention in Washington DC in 1958 that I heard a chap give a talk on why we should get rid of the Morse Code barrier to getting a ham ticket. I remember the convention because at the time my old submarine, the *Drum* SS-228, was tied up at the Washington Navy Yard and the convention had made visits to the boat available via buses. I spent a good part of the day showing hams through the *Drum*, explaining what all the valves were for, and what we did in all of the compartments.

Forty years ago the code barrier to a ham ticket no longer made any sense, so I started writing about it in my editorials. In 40 years no one has yet come up with a new excuse for maintaining this painful hazing barrier to entering hamdom.

Long ago I pointed out that the Moose Cud is a religious matter and thus not one open to a reasoned discussion. It's a matter of unfounded belief, with many of the true believers ready to kill (the hobby) to protect their belief. Well, we've seen the actions of religious fundamentalists who have killed nearly 100,000 in Algeria recently, so this should be no surprise. And then there's the fanatics in Iran, Afghanistan, and Jerusalem.

The fanatics won again at Geneva with the latest radio conference where any action on eliminating the Mace Clod from the ITU rules was postponed for another four years.

On the one hand, I rejoice — because this means that I'll be able to sell my Mince Coat course for another four years, making a fortune on the suffering of others. I have the fastest, easiest course there is for learning the fool Mercy Crud. If more potential hams knew how easy it is to ace the test using my system, we might not have the top-heavy Tech Class licensee numbers we have today. Almost anyone can pass the 13-per test in a weekend if they get my tape and follow my instructions. For that matter, 20 wpm doesn't take a lot longer.

An eon or so ago, right after the ARRL whipped their brainwashed multitudes to a frenzy (shades of the ayatollahs), protesting to the FCC over the proposed no-code ticket, I took them at their word. They claimed that the ability to use Moss Code was of critical importance for emergencies. So I said, okay, if that's what you honestly believe, then let's make sure that you don't lose that valuable skill — by having a code test at every ticket *renewal* time. Wow, the screams of anguish that one roused! They didn't mean that *they* should be able to copy the code any more, only that *newcomers* should.

I'm still seeing letters from hams convinced that the Mars Cold must be retained. Viva progress.

With the advent of thousands of tons of war-surplus gear, plus endless cheap parts from manufacturing overruns, ham radio got one heck of a jump start 50 years ago. That's when stabilized VHF gear became possible, and VFOs appeared for the low bands. We were on an inventing and pioneering jag, with NBFM and RTTY in the late '40s and SSB in the late '50s, followed by SSTV, moonbounce, solid state and then ICs. Then, 30 years ago, when the greatest catastrophe in the history of the hobby hit, our pioneering and progress virtually stopped.

At the time I got started in ham radio the code test no longer made much sense, and that was 60 years ago.

The fact that all amateur matters before the WRC in Geneva were tabled for the next WRC in four years shows that as far as most of the administrations around the world are concerned, we're not worth taking the time to discuss. For most countries our ham bands aren't yet badly needed.

If you read the reports on the 1997 conference you'll note that commercial interests have tight control of the ITU these days, so as soon as there is a commercial need for our ham bands, they'll come up for a "discussion" and subsequent loss at the ITU.

The ARRL board response to that? It's doing its best to discourage new hams from being interested in the hobby.

League Bashing? Me?

Actually, I'm more bashing my fellow League members. I should be getting my 60th year membership certificate and pin this year — a member since 1938, so I feel a vested interest in the League's responsibility to preserve and protect amateur radio.

My first beef is that the League has not stayed relevant to us hams. I see this in *QST* and in the total lack of communications from my Division Director, whoever he is, to keep me informed on what's going on in the hobby, what the League is doing to deal with current and known future problems, and to solicit my input (and that from all other ARRL members in our division). I see a serious problem in the membership totals, with only 22% of the General Class licensees being members, an almost invisible 16% of the Techs, and (wow!) 3% of the Novices (there are over 90,000 Novices).

With the major part of the newer licensees not getting *QST*, I can see why the ham industry is hurting so badly. Virtually all of the companies are advertising almost totally in *QST*, and the newer hams, the people who are buying their first stations, obviously aren't seeing the ads.

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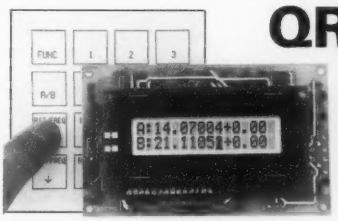

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LETTERS

From the Ham Shack

William H. Alliston W3ICB. Every 18-wheeler that leaves the factory with a load of cigarettes should carry along a couple of coffins for the convenience of the customers! When I tell that to my smoking friends, their response is usually something like, "No way (cough!), it can't (hack, cough!) be that bad. You're out (cough, cough!) of your mind." Well, maybe I am, but if you don't believe it, do the math:

1. A trailer truck can carry about a half-million packs of cigarettes.

2. With about 120 million smokers in the US, at two packs a day per smoker, it would take around 175,000 truckloads to meet their demand each year.

3. The American Cancer Society tells us that about 350,000 smokers die prematurely each year in this country from the effects of smoking.

4. Divide that 350,000 by 175,000 truckloads and you get two per truckload. To my way of thinking, that makes cigarettes one of the most dangerous cargoes transported in the US. It should beat out gasoline, nuclear waste, explosives and just about any other shipment you can think of.

Jeez, another troublemaker ... Wayne.

Rick Aiello, NY. During the 1980s I worked for the Eastman Kodak Co., Copier Division. I was determined to shine through hard work. I was not only productive, but very active in the company suggestion program. I submitted many suggestions that made a few extra bucks for me and saved Kodak thousands. I had so many reviewed and adopted that my supervisors were embarrassed by their overlooking these ideas and concepts during the R&D phase of the part or assembly. One viable suggestion was turned down "because it was already being done that way." What my supervisor did was when the suggestion package went across his desk, he went into the planning office and pulled the procedures file for the part. He then adopted my proposed change and tossed out the old plan and progress sheet. He was inept at his job and was threatened, so I set him up. My next suggestion was submitted after I made copies of all the pertinent process sheets. He did the same thing again and this time I had the copies to prove he'd altered the existing paperwork. After an investigation they dumped him, but on the next downsizing I got the door. So I went to work for a small company, learned the business, and two years later I was in business for myself. From making $600 a week I went to $5,000 a week. It was the best time of my life! Last year I sold my business and moved to the country.

As I've written, if you're working for a big company, you're a sucker. If you work for someone else for more than a couple of years, you're a sucker and deserve to be a proud member of the gradually disappearing middle class. Also, if you eat any food product advertised on TV, you're a sucker and you deserve every illness that results ... Wayne.

Guy A. Matzinger W1GUY. The latest chapter in the Morse Code soap opera has drawn to a predictable close, when the ITU World Radio Conference opted not to address Article S25 and the International Morse Code Treaty obligation. Their excuse: "Due to a crowded agenda, consideration of S25 will be put off until WRC2001 (or later?)." Reminds me of the movie *Conspiracy Theory*, in which Mel Gibson, when asked whether his various theories could be proven, said: "No. If they could be, something must have gone wrong." That puts conspiracies safely in the realm of imagination and conjecture. However, when Communist revolutionaries seized power in Russia, they emerged from the concealment of conspiracy into open dictatorship. Lenin was one of the most successful conspirators of all time. I am also reminded that some allegedly "democratic" amateur radio organizations are pretty good at aristocracy: the system, as Aristotle defined it, in which the virtuous elite decide things for the common individual. There's no denying that these organizations take to the pursuit and maintenance of power as naturally as sharks to open wounds. For months they have led a campaign against removing Morse Code requirements from the International Treaty obligation. Why? Why now, when contrary to some claims, today there is a good deal of evidence from around the world that suggests that either eliminating or limiting code tests to not more than 5 wpm does not cause congestion, revitalizes the economics of the hobby, induces the young to participate and expands membership in both local and national organizations, but maybe that is not what the spectrum keepers want.

It appears that these authoritarian conspirators, in combination with others, consorted to fight the specter of competition and skillfully waged a propaganda campaign that managed to bamboozle gullible administrations into believing that no country should be free to decide their own code testing course of action. What is the compulsion that really motivates these fanatics? Are they paladins of progress or frauds who would make international names for themselves as opponents of reform? The majority opinion means nothing to these guys, and whenever given the chance, they connive to restrain and limit participation in amateur radio.

Thousands of amateurs believe they are targeted by a licensing system determined to prevent them from participating in all aspects of the hobby. This perception of unquestioned reality, and the effect of this divisive policy, have overwhelmed the amateur community. Refusing to address or even to rethink code testing requirements will only tear this hobby apart—and do nothing to preserve the future of amateur radio.

Conspiracy? Maybe, but I suspect that amateur radio problems were tabled until the next WRC more because none of the participating administrations wanted to waste time on such small peanuts ... Wayne.

Rick Mudd KC7WGS. Where in the world did you dig up that whiner, Dr. Harold I. Goodman? When I read his "Letter from Down East" in the February issue I have to say that I was disappointed that you'd waste space on someone who obviously needs to find another hobby, or find a good anger management counselor. He obviously has time on his hands if all he can do is drift through the bands and find things to whimper about. Hey Doc! Here're some suggestions for you: (1) Buy a QRP rig and give it a try. One thing you don't seem to know is that it is usually not perfect operating with a rig that has two knobs on the front of it and usually a less-than-optimal antenna system. We QRPers appreciate you sticking with us, but just because you are putting out 1,000 watts, don't assume we're having a great time of it. (2) If you don't like the code you're hearing maybe you should help the local club provide lessons for new operators. I don't know about your area, but here in my neck of the

Continued on page 79

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Dayton Scholarships

The Dayton Amateur Radio Association is accepting applications for its annual scholarship program. Applicants must be amateur radio operators and graduating high school seniors. Eight scholarships of up to $2000 each will be awarded. To request an application, send an SASE to: DARA Scholarships, 45 Cinnamon Ct., Springboro OH 45066-1000. The application deadline is June 1.

Seen in *Harmonics*, newsletter of the South Jersey Radio Association, January 1998.

1998 Scholarships

The Foundation for Amateur Radio, Inc., a nonprofit organization with headquarters in Washington DC, plans to administer 66 scholarships for the academic year 1998–1999 to assist radio amateurs. The Foundation, composed of over seventy-five local area amateur radio clubs, fully funds nine of these scholarships with the income from grants and its annual Hamfest. The remaining 57 are administered by the foundation without cost to the various donors.

Licensed radio amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment at an accredited university, college, or technical school. The awards range from $500 to $2500, with preference given in some cases to residents of specified geographical areas or the pursuit of certain study programs. Clubs are encouraged to announce these opportunities at their meetings, in their club newsletters, on their nets and on their Web pages.

Additional information and an application form may be requested by letter or QSL card, postmarked prior to April 30, 1998, from:

FAR Scholarships
6903 Rhode Island Ave.
College Park MD 20740.

English Volunteers Win SETI League's Bruno Award

The SETI League, Inc., leaders in the privatized Search for Extra-Terrestrial Intelligence, has awarded its highest honor to two radio amateurs from England. Ken Chattenton G4KIR and Trevor Unsworth GØECP, who were the grass-roots group's first two volunteer Regional Coordinators, received the coveted Giordano Bruno Memorial Award for their contributions to amateur radio astronomy.

Three years ago at a conference in Scotland, SETI League executive director Dr. H. Paul Schuch was approached by Chattenton and Unsworth, who wanted to know how they could help build up SETI League activity in their native England. The SETI League was then a small US-based group made up primarily of amateur radio enthusiasts. It was clear that the organization could not contemplate mounting a scientifically significant SETI effort without extensive international cooperation. Ken and Trevor noted that The SETI League had neither the staff nor the resources to coordinate such a global search unaided. They then volunteered their considerable talents and energies to coordinating SETI League activity throughout the UK. Their success can be measured in part by the large number of radio, television, newspaper and magazine interviews they have granted during the past three years. But a better measure is the phenomenal growth in amateur SETI participation throughout the UK since Ken and Trevor stepped forward. Britain's SETI League contingent is now second only to that in the United States.

The English model for local involvement served as the basis for the current SETI League Volunteer Field Organization. Ken and Trevor were the first of a network which has now grown to about 40 regional coordinators on six continents, supporting an expanding membership base. The SETI League owes its current international profile in no small part to the vision and energies of these two dedicated volunteers.

SETI scientists seek to determine through microwave measurements whether humankind is alone in the universe. Since Congress terminated NASA's SETI funding in 1993, The SETI League and other scientific groups have been attempting to privatize the research. Experimenters interested in participating in the search for intelligent alien life, or citizens wishing to help support the search, should visit SETI on the Web at [http://www.setileague.org/], send E-mail to [join@setileague.org], FAX them at (210) 641-1771, or contact The SETI League, Inc., membership hotline at (800) TAU-SETI. Be sure to provide a postal address to which further information can be mailed. The SETI League, Inc., is a membership-supported, nonprofit [501(c)(3)], educational and scientific corporation dedicated to the electromagnetic Search for Extra-Terrestrial Intelligence.

From a press release of The SETI League, Inc., March 21, 1998.

Are You Sure?

Some computer terms everyone should know—

Amiga: A Merely Insignificant Game Addiction

Apple: Arrogance Produces Profit-Losing Entity

CD-ROM: Consumer Device—Rendered Obsolete in Months

COBOL: Completely Obsolete Business-Oriented Language

DEC: Do Expect Cuts

DOS: Defective Operating System

GIRO: Garbage In, Rubbish Out

IBM: I Blame Microsoft

ISDN: It Still Does Nothing?

LISP: Lots of Infuriating and Silly Parentheses

Macintosh: Most Applications Crash; If Not, the Operating System Hangs

Microsoft: Most Intelligent Customers Realize Our Software Only Fools Teenagers

MIPS: Meaningless Indication of Processor Speed

OS/2: Obsolete Soon, Too

PCMCIA: People Can't Memorize Computer Industry Acronyms

Pentium: Produces Erroneous Numbers Through Incorrect Understanding of Mathematics

SCSI: System Can't See It

Windows: Will Install Needless Data On Whole System

WWW: World Wide Wait

A tip of the *73* floppy to KB6CMO for this piece which originally appeared in *The BPARC Communicator* (August 1997) and was reprinted in the *ARNS Bulletin* (November 1997).

Got Us Covered?

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Yeah, yeah, you say, but I'm not a pro. So what? The vast majority of cover shots for *73* over

Continued on page 48

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An RF Sensing Alarm

Save your power amplifier stages ... and your reputation!

Bertrand Zauhar VE2ZAZ
4176 Sylvio St.
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Canada

Have you ever walked into your shack and found out that one of your transceivers was on the air? Surprise! That has happened to me twice in the last couple of years. Once, it was the packet TNC that had crashed, leaving the two meter transceiver on the air for I don't know how long. That obviously blocked the entire packet BBS traffic. Whoops! The second time, my 70 cm satellite uplink transceiver and amplifier had been shooting 100 watts of RF at the stars for 30 minutes without my consent, thanks to one of the gizmos I had built to control the rig. Try to guess how hot the linear was! I decided that I'd had enough. Another occurrence and I would jeopardize my reputation forever.

I had to build a device that would alert me when it detected a continuous RF transmission lasting more than five minutes (a safe margin since I usually do not read the newspaper on the air!). The device would have to be broadband (HF/VHF/UHF), be sensitive enough to detect a five-watt transmission from inside the shack using a telescopic antenna, and produce a sound loud enough to alert me anywhere in the house. It would also have to be self-contained, without any hookups to my radios. After a bit of reading and thinking, I came up with a solution that meets all the initial objectives. Here it is in detail.

Circuit description

The circuit shown in **Fig. 1** may look scary for some of you, but it isn't. It can be broken down into four stages. Let's look at them one at a time.

The first stage acts as an RF sensor circuit. It is made of U1C, one of the four operational amplifiers of an LM324 chip, and its associated input circuitry. U1C is used as a voltage comparator. Note that the two U1C inputs (plus and minus) have similar DC circuits connected to them. The plus input has R7, R8 and D3, and the minus input has R6, R10 and D5. In these two circuits, D3 and D4 are partly biased (about 200 mV of forward voltage) to better exploit the variation of voltage versus current that the diode produces. This translates into increased RF sensitivity.

In an idle condition (no RF detected), potentiometer R10 is set to make the voltage at the minus input of U1C slightly lower than that at its plus input. This keeps the output of comparator U1C saturated to the "high" state (near supply V+). A strong RF signal present at the antenna terminal J1 reaches D3, a Schottky diode, through C3, a coupling capacitor. The diode rectifies this signal and generates a drop of voltage at D3 anode. This makes the voltage at the plus input of U1C fall below the one set at the minus input. As a result, the output of comparator U1C flips down to the "low" state (near ground). In this state, the circuit is in RF detection mode and timer U1B is activated. Note that as soon as the RF signal disappears, the comparator immediately returns to its high state, resetting the entire alarm circuit. Ferrite bead FB1 and resistor R8 are used to block the RF from reaching comparator U1C. Additional RF decoupling is provided by capacitors C2 and C5.

The second stage acts as a timer. It is made of U1B, D4, C4 and R9. U1B is again used as a voltage comparator. When no RF is detected, capacitor C4 is kept charged by the "high" state of U1C. When RF is detected by the first stage, capacitor C4 is left "floating" and starts to slowly discharge through R9. When C4 is sufficiently discharged,

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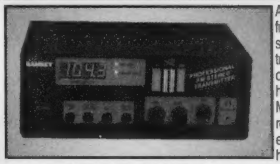
Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit.....$129.95

Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply. We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. *The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.*

FM-100, Professional FM Stereo Transmitter Kit.....$299.95
FM-100WT, Fully Wired High Power FM-100.....$429.95

The Cube World's Smallest TV Transmitter

Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies-that's a nickel in the picture! Transmits color or B&W up to 150' to any TV tuned to cable channel 59 with a solid 20 mW of power. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Deluxe model includes sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Our cameras shown below have been tested to mate perfectly with The Cube and work great. Fully assembled.

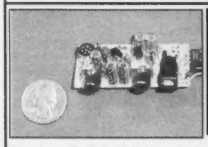
C-2000 Video Transmitter Cube.....$89.95
C-3000 Video and Audio Transmitter Cube.....$149.95

Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit.....$34.95
CFM, Matching Case and Antenna Set.....$14.95

CCD Camera Interface Board



Here's a nifty little kit that eases hook-up of your CCD camera module to any video monitor, VCR or video input TV set. The board provides a voltage regulated and filtered source to power the camera (CCD Cameras require a stable source of power for best operation), sensitive electret condensor mike for great sound pick-up and RCA Phono jacks for both audio and video outputs. Runs on 11 - 20 VDC

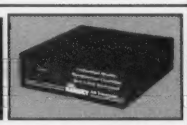
IB-1 Interface Board Kit.....$14.95

RF Power Booster Amplifier

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

LPA-1, Power Booster Amplifier Kit.....$39.95
CLPA, Matching Case Set for LPA-1 Kit.....$14.95
LPA-1WT, Fully Wired LPA-1 with Case.....$99.95

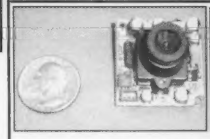
AM Band Radio Transmitter



Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper setable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

AM-25 Professional AM Transmitter Kit.....$129.95
AM-1 Entry level AM Radio Transmitter Kit.....$29.95
Cam Matching Case Set for AM-1.....$14.95

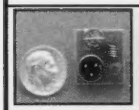
CCD Video Cameras



If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. These cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, these are super IR (Infra-Red) sensitive! Available with Wide-angle (80°) or super slim Pin-hole style lens. Both run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our Interface board (below) for Audio sound pick-up and direct wire connection to any Video monitor or TV video/audio input jacks. Fully assembled.

CCDWA-2 CCD Camera, wide-angle lens.....$99.95
CCDPH-2 CCD Camera, slim fit pin-hole lens.....$99.95
IR-1 IR Illuminator Kit.....$24.95

Micro FM Wireless Mike



World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to108 MHz. 7/8"w x 3/8"h x 3/4"h.

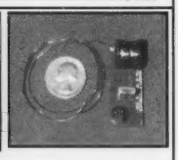
FM-5 Micro FM Wireless Mike Kit.....$19.95

Tone-Grabber Touch Tone Decoder / Reader

Dialed phone numbers, repeater codes, control codes, anywhere touch-tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

TG-1, Tone Grabber Kit.....$99.95
CTG, Matching Case Set for TG-1 Kit.....$14.95
TG-1WT, Fully Wired Tone Grabber with Case.....$149.95
AC12-5, 12 Volt DC Wall Plug Adapter.....$9.95

Crystal Controlled Wireless Mike



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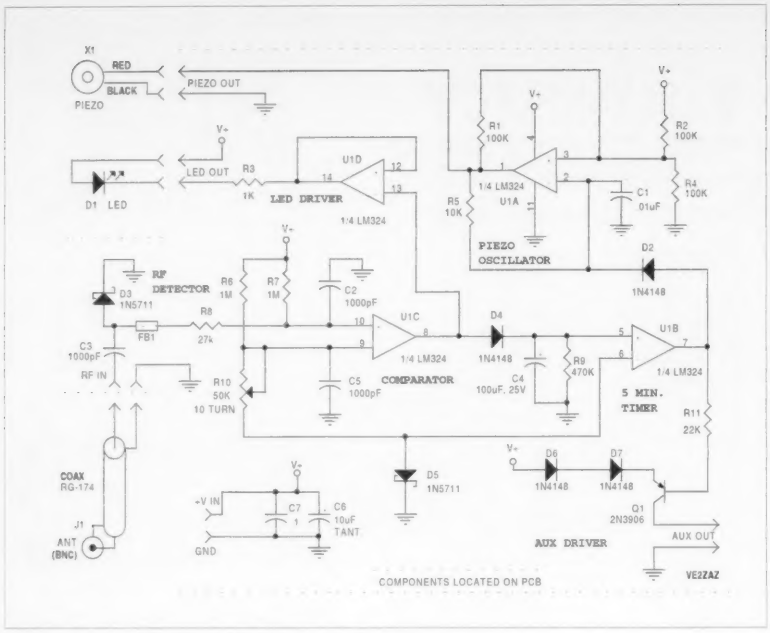

Fig. 1. *Circuit diagram for the RF Sensing Alarm.*

after approximately five minutes, the voltage at the plus input of U1B falls below the one at the minus input which is set by D5 (about 200 mVDC). As a result, the output of comparator U1C flips down to the "low" state (near ground). In this state, the alarm is tripped. The timer stage drives piezo oscillator U1A and PNP transistor Q1. The latter is added to drive an external device with a voltage close to V+ when the alarm is tripped. The two diodes in series with the emitter provide a drop of voltage so that the base-emitter junction of Q1 is not biased when U1B output is in "high" state. The 2N3906 or equivalent transistor will safely supply a current of up to 50 mA.

The third stage is an astable multivibrator (square wave oscillator) and is made of U1A and surrounding components. It drives the piezo transducer to produce a loud high-pitched sound. The oscillator circuit will operate only when the output of U1B presents a "low" state. Diode D2 serves as an isolating device between the two stages when U1B is in "low" state. The oscillator's frequency is set by capacitor C1 and resistor R5. The values chosen make the circuit oscillate at approximately 2600 Hz, a frequency that causes the piezo to generate the loudest sound.

The last stage is a simple buffer U1D that sinks current to turn on LED D1 whenever an RF signal is sensed by U1C. R3 limits the current to a safe level for the buffer, less than 20 mA.

The balanced input configuration of comparator U1C allows the supply voltage V+ to vary over a wide range and the entire circuit will still work. I designed the circuit for a 13.8 volts supply, but I verified that the circuit works down to approximately 10 volts without recalibrating it, and down to approximately five volts if recalibrated. The high end of the range is more delicate to set since devices such as the LED, the piezo transducer and polarized capacitors may be overstressed if component value changes are not made. Consequently, I would not recommend going beyond 20 volts.

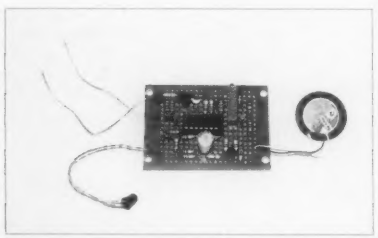

Photo A. *The prototype, assembled on a universal printed circuit board.*

Circuit assembly

This project is relatively inexpensive to assemble. If all the components are purchased, it should cost less than $25 to build it. Obviously, your junk box's size will dictate the cost. I reused components taken from old PCBs and built the project for less than five dollars, including PCB and box.

As shown in **Photo B**, I elected to design a PCB for the project. It is a rather compact design. The intent here is to make the PCB fit in a common Hammond 1591A plastic box. Note that the circuit can be assembled using other techniques: universal PCB, veroboard, dead-bug, wire-wrap and even a combination of these techniques. The layout is not critical except for the RF portion of the circuit: Components D3, C3, FB1 and R8 should be mounted as close as possible to each other, using very short leads. This will guarantee proper operation up into the UHF spectrum. Also, decoupling capacitors C2 and C5 should be mounted as close as possible to pins 9 and 10 of U1C.

An IC socket for U1 is desirable since the LM324 is rather sensitive to pin shorting compared to other operational amplifiers I've used in the past. With a socket, replacing it is a snap.

Ferrite bead FB1 is inserted over a short piece of solid wire and the wire is soldered to the PCB pads. Potentiometer R10 is located on the PCB edge so that its adjustment screw can be accessed through a small hole drilled on one of the faces of the box. I've chosen not to put connectors for external connections to the LED, the piezo transducer, supply line and the auxiliary output. Solder small gauge (#26 or smaller) wires directly to the PCB pads and connect the other ends to the external devices.

For antenna connection, I recommend using a female panel-mount BNC connector. It is small, reliable and will accept most right-angled telescopic antennas when mounted horizontally. Other RF connectors can be used if desired. Since the input impedance of the circuit is quite high, maintaining a constant impedance through the connectors is not an issue. In general, though, it is good practice to

avoid using UHF connectors (PL-259/SO-239) when working above 200 MHz, since they are not of constant impedance type. For coaxial cable, a short piece of RG-174 type or equivalent is preferred to limit overstressing of the PCB pads. This type of coax is much easier to route in a small box anyway. Solder the bare ends directly to the pads.

Someone may decide that five minutes of margin before alerting is too short. C4 and R9 make up the RC circuit that determines the duration. The discharge rate can be varied by changing the value of C4 and/or R9. **Fig. 2** shows a plot of resistor R9 as a function of time for different supply voltages V+. This graph gives a ballpark idea of the resistor value to pick. I computed this graph using a tantalum capacitor for C4. I verified that, in general, tantalum capacitors match closer to the theoretical exponential discharge curve than do electrolytic capacitors. If an electrolytic capacitor is used instead, the user can expect to get about 10 % longer duration than what is indicated on the graph. Electrolytic capacitors are far from being perfect devices (farther than tantalum) and their unwanted characteristics tend to lengthen the discharge duration. Also note that tolerances on the capacitor values will affect the duration as well.

Some comments

Piezo transducers have a resonance frequency that, when submitted to, produces the loudest sound. The piezo I used came out of my junk box. I found that a 10 k resistor for R5 produced the loudest, most unpleasant sound. Using a different piezo element may require a different value of resistance. I suggest temporarily connecting a 50 kΩ potentiometer to find your piezo's "sweet spot." You can then measure the required resistance with an ohmmeter directly on the potentiometer and substitute it with the closest resistor value at the end.

You may have noticed that some piezo transducers have three wires and some have two. Only two wires are used here. The third wire is a feedback signal. If the piezo you are using has three wires, the black wire goes to ground, the red goes to the oscillator and the blue (or other color) is not connected.

Make sure you use an "external drive" type of piezo transducer. Some piezos come with built-in oscillator circuits and will only function if they are connected to the auxiliary output provided by Q1.

Finally, if means of alerting other than piezo are preferred, you can use the auxiliary output to drive an external device. In this case you don't have to install components R1, R2, R4, R5, C1 and D2. Put jumper leads at the place of C1 and R4 to ground the unused LM324 inputs.

Continued on page 14

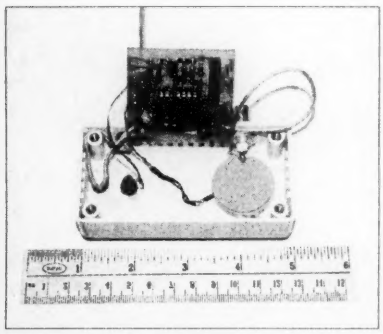

***Photo B.** The fully wired unit, before closing the cover.*

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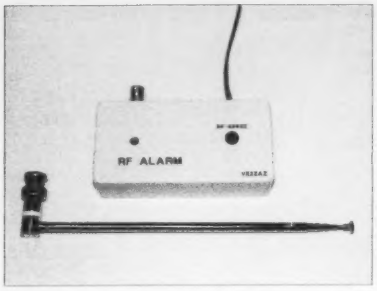

Photo C. *The completed project and the telescopic antenna.*

Calibrating and testing

When everything is assembled and visually inspected, it is time to apply DC supply to the circuit. When doing so, if the piezo sounds right away, adjust R10 until it stops. If you can monitor the supply current to the design using an ammeter, it should be less than 10 mA. Next do the touching test. There should not be any hot components.

Diodes D3 and D5 must be at the same temperature before calibration is performed. This is critical since temperature offsets can create millivolts of difference and unbalance the circuit. Do not touch the PCB for a few minutes before going any further. To calibrate the unit you will need a digital voltmeter of 10 MΩ or higher input impedance that can read down to the millivolt. First connect the voltmeter between U1C pin 10 and ground. Measure the voltage and make a note of it. Then move the voltmeter's red probe to U1C pin 9. Adjust potentiometer R10 to bring the voltage at pin 9 higher than the voltage previously measured at pin 10. The LED should turn on. Backing off on R10 to bring the voltage below the one at pin 10 should turn off the LED. This verifies that the comparator stage is working properly. Now, adjust potentiometer R10 so that the voltmeter reading on pin 9 is three to five millivolts lower than the value noted from pin 10. This completes calibration.

At this point you are ready to verify the circuit using RF. Attach an antenna to J1. Transmit a constant amplitude signal (AM, FM, modulated SSB) from any of your radios with at least five watts of output power (using another antenna, of course!) and verify that the LED comes on when RF is present. Moving the antenna around in the shack, for example close to a window, may give better results. To verify the alarm circuit, you must maintain RF presence for at least five minutes before you can hear the sound. Make sure the frequency chosen will not interfere with ongoing QSOs, and identify yourself often. When the alarm sounds, stop transmitting and verify that the alarm stops and that the LED turns off. Try detecting RF at other frequencies to verify sensitivity flatness.

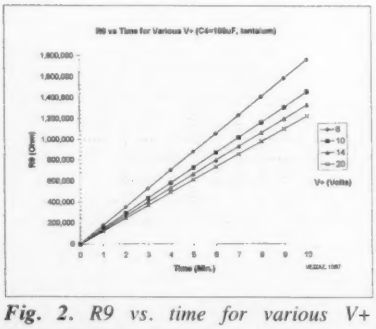

Fig. 2. *R9 vs. time for various V+ (C4=100 µF, tantalum).*

Performance

Using a calibrated signal generator, I verified that the alarm's sensitivity is about seven millivolts RMS of RF and is quite flat from 1 MHz to 550 MHz. Sensitivity depends on how close the two voltages at the inputs of comparator U1C are. The circuit is stable as long as the entire design is at the same temperature. This is the case when all the electronics are enclosed in a box. I've used the alarm for a few months now and haven't had to recalibrate it. Since the RF sensing circuit is not tuned, selectivity is dictated by the type of antenna used. I found that about two feet of antenna is enough for proper operation at all frequencies, HF, VHF, UHF. I put the alarm box on top of my radio console and I use a telescopic antenna. Note also that my shack is located in a basement. A bit of experimenting here with antenna type, position and length may be required. I've also verified that I can hear the alarm sounding wherever I am located in the house. This sound is equivalent to a smoke detector, so you shouldn't have any problems hearing it.

I have not been alerted by my new alarm yet, but it gives me a peace of mind that I never had before. Knowing that it's there makes all the difference! 73

Parts List

C1	.01 µF ceramic
C2, C3, C5	1000 pF ceramic
C4	100 µF, 25 V tantalum or electrolytic
C6	10 µF, 25 V tantalum or electrolytic
C7	.1 µF ceramic
D1	LED, any color
D2, D4, D6, D7	1N4148 or equivalent
D3, D5	1N5711 Schottky
FB1	Ferrite bead
J1	BNC, female panel mount
Q1	2N3906, PNP or equivalent
R1, R2, R4	100 k, 1/4 W 5%
R3	1 k, 1/4 W 5%
R5	10 k, 1/4 W 5%
R6, R7	1 M, 1/4 W 5%
R8	27 k, 1/4 W 5%
R9	470 k, 1/4 W 5%
R10	50 k, 10-turn pot (Bourns 3006 type)
R11	22 k, 1/4 W 5%
U1	LM324 quad op amp
X1	Piezo, MuRata PKM-11 or Radio Shack #273-73 or equivalent
Socket	14-pin DIP
Coax	RG-174 or equivalent
Box	Hammond 1591A suggested
Right-angle BNC telescopic antenna	

Table 1. *Parts list.*

A Pleasant Visit to the DDS

Direct Digital Synthesis is the latest technology in signal generation.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

There has been quite an evolution over the years in signal generation and frequency control. Signal generation began by using a self-excited oscillator, the stability of which left a lot to be desired. As more signals appeared on the bands, greater oscillator stability was sought. The need for improved stability embraced the use of quartz crystals, which solved the stability problem. Later on, the demand for multiple frequency channels increased and created a new set of problems requiring the use of many crystals in a single radio. The cost of the radio was driven upward as a result.

The answer to these problems was the development of the Phase-Locked Loop (PLL) synthesizer, which provided multiple frequency capability along with the stability of the quartz crystal at every generated frequency. The latest technology in frequency synthesis is called Direct Digital Synthesis (DDS) and differs greatly in design from the PLL system, yet the end result can be the same. Before discussing the DDS system, it is perhaps best to review the PLL system in order to establish a comparison of the frequency synthesis processes involved.

PLL synthesizer

Frequency synthesizers get their name from being able to generate a great number of discrete frequencies with the same stability as that of a quartz crystal while utilizing perhaps only one crystal (although more than one may be used in the synthesizer in order to meet specific design criteria).

A PLL synthesizer is shown in **Fig. 1**, in which a VCO (voltage-controlled oscillator) is used to generate the output signal. To set the VCO to a specific frequency, it is necessary to lock it to a stable frequency source, which, in this case, is a clock. A clock, in reality, is a quartz crystal oscillator. To make the PLL circuit function, the signal output of the VCO and the output from the clock are compared in a phase detector where the phase angle will always be 90 degrees when the VCO is locked to the clock. Should the VCO attempt to shift in frequency, the phase detector will develop a DC output voltage sufficient to steer the VCO back to a phase difference of 90 degrees. In other words, the VCO is phase-locked to the clock.

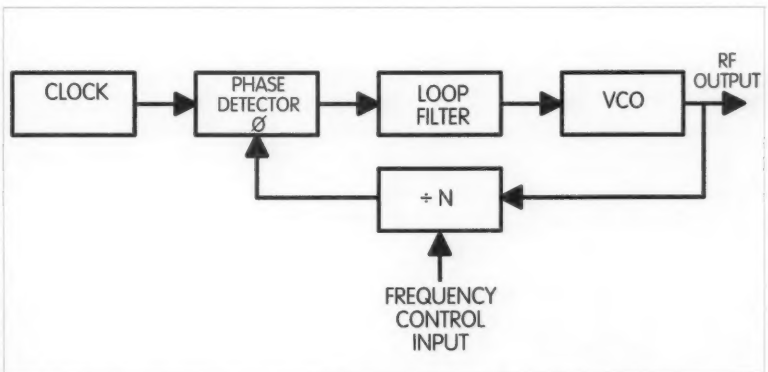

Fig. 1. *Block diagram of a basic phase-locked loop system with the major functions shown.*

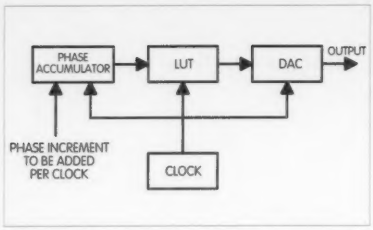

Fig. 2. Block diagram of a basic DDS with the major functions shown.

It isn't necessary that the clock and VCO be on the same frequency. In fact, they are rarely ever on the same frequency. To achieve a frequency separation and still obtain the 90-degree phase shift, the signals fed into the phase detector may be shifted to any design-convenient frequency, typically lower. A frequency divider is placed between the VCO output and the phase detector to create a frequency lower than the operating frequency of the VCO. In most cases, the frequency divider will have a variable divide ratio (divide by N) so that a multiple set of frequencies can be generated by the VCO with each output frequency phase-locked to the clock frequency. Incremental frequency steps are created by changing the divide ratio (N) through a set of switches.

Also included in a PLL system is a device called a loop filter. The purpose of the filter is to reduce the rate of VCO response to an output from the phase detector. Should the VCO response be too fast, it could swing too far (frequency-wise), get partially out of control, and then swing like a pendulum. The result would cause the VCO to swing back and forth at a fast rate. A loop filter is used to reduce the VCO response speed (or slew rate) in order for it to gain a phase-locked condition.

PLL frequency synthesizers suffer from several problems, such as: (1) frequency resolution (large step values); (2) settling time (lock access timing); (3) bandwidth limitations (tunable range); and (4) phase noise (jitter). Most of these problems have been controlled sufficiently and are usually transparent to the user. However, PLL frequency stability is still an issue and is affected by two primary faults. The two faults are the stability of the VCO and the phase noise caused by a high divide ratio. This latter fault has essentially been solved through the use of a dual modulus synthesizer design.

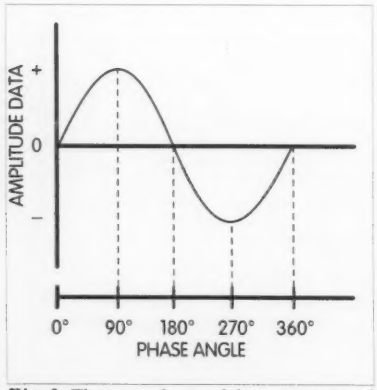

Fig. 3. The waveshape of the output signal from a DAC as mapped in the LUT.

DDS system

As important as the PLL synthesizer was to the evolution of radio communication, the latest synthesizer development solves many of the PLL problems and opens the door to many new applications, but adds a few problems of its own. The new synthesizer is called a Direct Digital Synthesizer (DDS), and a very basic one is shown in **Fig. 2**.

It is composed of four major components: phase accumulator, look-up table (LUT), digital-to-analog converter (DAC), and clock. The DDS is not intended to be a replacement for the PLL system, as each synthesizer has its useful merits for specific applications. In many new design applications, both the DDS and PLL systems come together and solve some of the ills associated with each if used alone.

In a DDS, the DAC creates an analog output signal based upon a defined amplitude which is presented as a digital word. As a result, any desired waveform can be generated by defining the input word to the DAC. Unlike other signal generators, the DDS does not require a resonant circuit, as the signal is generated as a voltage amplitude with respect to time.

Ahead of the DAC is an LUT, which is really the core of the DDS in that it maps the waveshape of the output signal as a function of phase angle from 0–360 degrees as shown in **Fig. 3**. An LUT is actually a ROM chip that is programmed to produce an amplitude at a given phase angle. The ROM mapping determines the waveform that will be produced, and it's possible that several waveforms can be mapped within the ROM with each at a selectable range of addresses.

In high frequency DDS systems, the LUT is usually made more efficient by programming it to define only the first 90 degrees of the waveform, since the remaining 270-degree portion can be generated by reflecting the first 90 degrees in different ways. The objective is to improve the resolution of the ROM response at the higher clock frequencies.

Ahead of the LUT is a phase accumulator, which is simply a counter or "adder" form of device that provides the input to the LUT. The phase accumulator is the rate controller, where the output frequency is controlled by the value added to the accumulator per each clock cycle. Consider an accumulator looking like P = P + X, where P = phase angle and X = the number of degrees to advance per step.

The sequence would continue, with P increasing by the value X from zero through 360 degrees of the output signal. At the completion of 360 degrees, the phase accumulator would roll over and start again from zero. Controlling the output frequency is then a matter of how often the sequence is to be repeated per unit of time. The actual input control can be done manually with coded switches, counter, ROM, or a microprocessor/microcontroller. More advanced systems use a microcontroller for application flexibility.

For a signal to be useful, we must define it in terms of frequency, phase, and amplitude. When all of these are combined with respect to time, the output waveform will be determined. In a DDS, each waveform is defined by and/or in response to a digital word. The greater the number of bits in the control word, e.g., 4, 8, 16, 32, etc., the higher the resolution of the DAC response. The LUT contributes to the signal definition by the number of

points of comparison (amplitude vs. phase angle) where the difference between the points of comparison creates some minor distortion or phase error. The amplitude approximations caused by the DAC's sampling points per clock cycle affect the output amplitude resolution.

The waveform and function (sweep, frequency hopping, modulation, etc.) are clocked through the DAC at a clock frequency which controls the upper frequency limit of the DDS, where the upper limit is one-half of the clock frequency (the Nyquist rate). Nyquist refers to the highest signal frequency that may be represented by a digital sampling method which is equal to one-half the sampling frequency (clock frequency).

The lower frequency limit of a DDS is near zero or about 1 Hz. Since the DAC works from sampling points, at one-half of the clock frequency (which is the highest output frequency), it has only two amplitude points (maximum and minimum) to work with in order to define the output waveform.

As an example of the upper frequency region, a 50 MHz clock allows the DDS to generate frequencies up to 25 MHz. The frequency step increment produced by the DDS is determined by the digital word, and it's possible to generate incremental steps with a DDS system down to fractional increments of one Hertz. It is common in modern communications equipment to have frequency increments in 1 and 10 Hz steps.

Modulation techniques

A DDS system can be modulated to create the same or similar modulation results obtained from one of the more common signal sources. Modulating a DDS is a matter of controlling the digital word format with respect to clock timing at the desired point in the circuit. **Fig. 4** shows the various circuit locations where an AM and FM modulation mode may be introduced. Any audio amplitude variation that can be translated to an instantaneous digital word change will modulate the DDS.

The placement of the word change within the circuit determines the modulation mode that will be created:

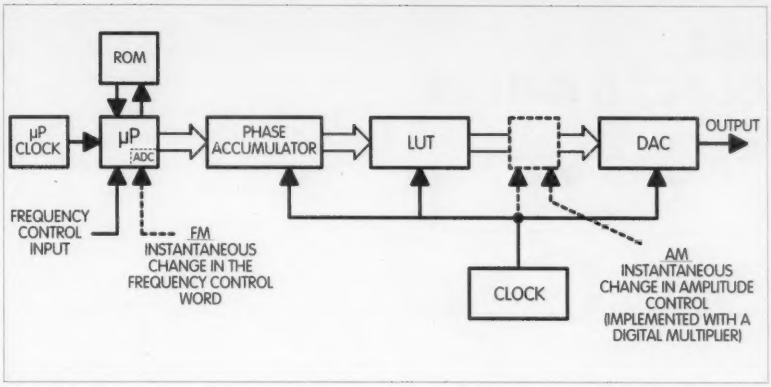

Fig. 4. Microprocessor-enhanced DDS with control points shown for creating AM and FM modulation modes.

•Frequency modulation (FM) requires that an instantaneous change be made in the frequency control word.

•Phase modulation (PM) is a phase shift phenomenon and may be introduced by creating an instantaneous change in the timing between the control word and clock.

•Amplitude modulation (AM) may be created by a word rate change at the input of the DAC. A digital multiplier is used to alter the word emitted from the LUT, which in turn causes the DAC to create a signal with an amplitude change following the desired amplitude modulation envelope.

Predictable output and shortfalls

Yes, there are some shortfalls with a DDS system such as spurious responses and alias frequencies. In comparison to a PLL, the phase response jitter of a PLL is not present in a DDS, but some spurious responses are produced in the signal output by the DAC. These spurious responses are caused by DAC decoding errors and amplitude approximations, the results of which are not predictable. Because the spurious responses occur close to the desired output frequency, they are very difficult to filter out. The most obvious problem with the DDS, however, is alias signals, which can be removed by

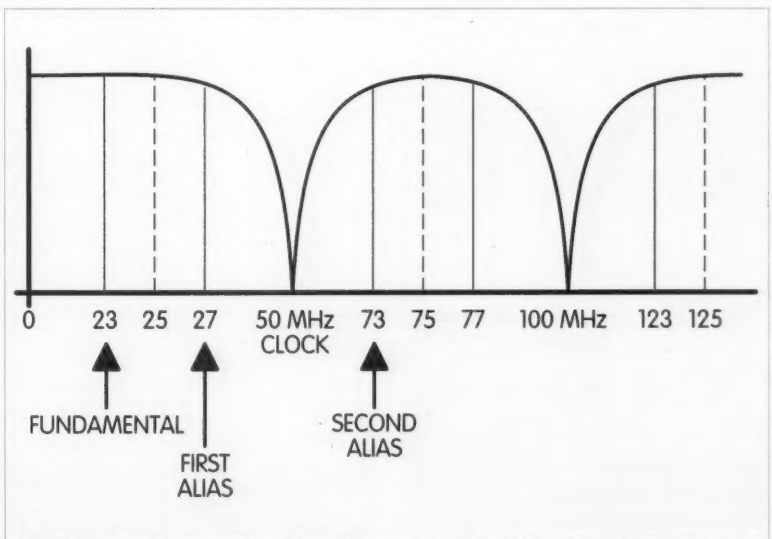

Fig. 5. DDS output frequency spectrum showing alias and harmonic frequencies.

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filtering the output signal. Filtering of the output also improves the spectral purity of the signal by removing the alias signals and the DAC-imposed amplitude approximations.

However, with the alias filter removed, the DDS will provide predictable alias signals and harmonics well above the clock frequency, as shown in **Fig. 5**. The alias frequencies are found by adding and subtracting the fundamental output signal to/from the clock frequency. As shown, a fundamental frequency is being generated at 23 MHz, which is 27 MHz below the 50 MHz clock (27 = 50 - 23). Simultaneously, an alias signal is produced 23 MHz above the clock at 73 MHz (73 = 50 + 23). If the fundamental is shifted to 22 MHz, the alias frequencies will be 28 MHz and 72 MHz. A similar frequency set will be observed at each harmonic of the clock frequency.

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Applications

The applications of a signal source are countless, regardless of the method used for generating the signal. However, a DDS especially lends itself as a natural for the following applications:

•Spread spectrum where frequency hopping is a requirement.

•Frequency and phase shift keying.

•Digital TV.

•Digital audio used with computers and compact disks.

•Signal generation requiring precise frequency settings and small incremental frequency steps.

•Frequency synthesis in communication radios.

•Use as the local oscillator in a receiver where the local oscillator frequency is offset from the displayed frequency to accommodate a receiver's IF.

•Test bench signal and waveform generator.

Regarding the signal and waveform generation capability of the DDS, it will generate most any repetitive waveform including a square wave. However, the square wave rise time at the highest output frequency of the DDS is compromised by the one-half clock frequency timing. The rise time improves as the output frequency is lowered.

Conclusions

A DDS can be programmed to produce many different waveforms at incremental frequency steps from a fraction of a hertz to larger step values. Because of its versatility, the DDS has created signal source design opportunities not previously available.

For those interested in using the DDS as a signal generator, the predictable outputs of the fundamental, harmonic, and alias frequencies are stable and suitable for use as identifiable signals. It must be noted, though, that the generation of multiple signals will be present within the frequency spectrum when an alias filter is not used. The addition of an alias filter to the output of a DDS will make it a superior frequency source having high signal and spectral purity because all signals generated above one-half the clock frequency will have been removed. 73

Sensitivity Training

Some pros and cons of increasing receiver sensitivity.

Parker R. Cope W2GOM/7
8040 E. Tranquil Blvd.
Prescott Valley AZ 86314

It seems we're always scratching for a little more sensitivity, but sometimes our scratching just makes a bad situation worse. A low noise amplifier (LNA) can help in special circumstances, and those are usually found above 15 meters. In the HF range below 20 MHz, the noise the signal is competing with is primarily manmade, but atmospheric noise produced by lightning discharges in thunderstorms can be a major problem depending on the time of day, season, weather, location, and frequency. The QRN on 160 meters and 80 meters in the summertime can be a bear. Manmade noise is an inverse function of frequency and depends on location, in that it is due chiefly to electric motors, neon signs, power lines, ignition systems, and the ubiquitous TV receivers' sweep generators. Above 30 MHz, manmade noise is about equal to thermal noise.

Thermal noise is generated in the thermal agitation of electrons in a resistance and is independent of frequency. The electron or hole flow in a transistor or the electrons flowing from cathode to plate in a vacuum tube are discrete units of charge occurring randomly. Their sum makes up the DC current, and their RMS value makes up the AC value. The AC component exhibits all of the characteristics of thermal noise. The RMS variation of transistor current is difficult to predict, and only under special circumstances such as in temperature-limited diodes can it be defined statistically. Thermal noise power (watts) available from a resistor is expressed as kTB, where k is Boltzman's constant, 1.38×10^{-23}, T is the absolute temperature in degrees Kelvin (room temperature is about 300° K), and B is the noise bandwidth in hertz (essentially the 3 dB bandwidth). kTB has a value of -203 dBW or -173 dBm per hertz. In a 1 kHz bandwidth, the noise power is -143 dBm.

The maximum available power from a generator is obtained when the load resistance equals the generator's resistance. Therefore, the RMS value of the noise voltage from a resistor R is:

$$e_n = \sqrt{(4kTBR)}$$

The radiation resistance of an antenna produces thermal noise, which is the minimum signal available from the antenna. As far as the receiver is concerned, noise from the antenna is just more signal. The noise the desired signal must compete with is the sum of the antenna's noise and the noise generated within the receiver. We can't do anything about the noise generated by the antenna, but the noise generated in the receiving system is a different story. We can increase the antenna's signal and noise to a level that overrides the receiver's internally generated noise. Generally, we are stuck with the receiver's internal noise, but some receivers are better than others.

The sensitivity of HF receivers is often given in terms of the RF signal at the input of the receiver needed to produce some signal-to-noise ratio S/N at the output. For example, an HF receiver may be specified as 0.5 µV for 10 dB S/N. VHF and UHF receivers usually specify the sensitivity in terms of "Noise Figure" or "Noise Factor," which is a comparison of the equivalent noise at the input of the actual receiver to the noise at the input of a perfect noisefree receiver when fed by a generator with a matching source resistance.

The noise factor of a network or "black box" can be defined as follows:

$$F = (S / kTB) / (S_o / N_o)$$

where

F = noise factor of the network

S = signal power available from the source

S_o = signal power available from the network

N_o = noise power available from the network

k = Boltzman's constant

T = absolute temperature of the signal source

B = noise bandwidth of the network.

The network is an undefined "black box" that can be active or passive and have a gain of greater or less than one. kTB represents the noise available from a resistor (the signal source's resistance) of arbitrary value at a temperature T and is merely a restatement of the usual expression for Johnson noise. The qualitative meaning is that a signal, no matter how it arises, has associated with it at least a minimum amount of noise, kTB. If the signal passes through a network that does not add noise, the ratio of signal power to noise power at the output will be the same as the signal-to-noise ratio at the input and the noise factor will be unity.

Noise figure NF is simply noise factor F expressed in dB, or NF = 10 x log F. The receiver's noise factor is usually determined by its first one or two stages, and is obviously a function of the receiver's design. The overall noise factor F of two cascaded networks is expressed as:

$$F_{12} = F_1 + (F_2 - 1) / G_1$$

where

F_1 = the noise factor of the first stage

F_2 = the noise factor of the second stage

G_1 = the power gain of the first stage.

When G_1 is large or F_2 small, the overall noise figure is essentially F_1. When G_1 is small, the noise factor of the second stage assumes greater importance.

For example, if the transmission line between the antenna and the receiver is considered the first network, F_1 may be 1 but transmission line losses make G_1 less than one and transmission line losses become critical.

The losses per foot in the transmission line are dependent on frequency and the construction of the line. At 150 MHz, RG-58 has about 7 dB loss per 100 feet and about 3 dB per hundred feet at 15 MHz, while 3/4-inch hard line has less than 1 dB loss at 150 MHz. Cable losses of RG-58 on two meters can be significant when the run between antenna and receiver is long. The cable may have a noise factor of one but the gain is low—7 dB loss is a gain of 0.2. The overall system noise factor for a receiver with a noise factor of 10 dB (noise factor of 10) fed with coax with a loss of 7 dB (gain of 0.2) is:

$$F_{12} = 1 + (10 - 1) / 0.2 = 1 + 45 = 46$$

$$NF = 10 \times \log 46 = 16.6 \text{ dB}$$

The noise figure of the receiving system is increased essentially by the loss of the cable. When the cable is preceded by a preamp, the equivalent preamp gain is simply reduced by the cable loss, but its noise figure is unchanged. A preamp with an NF of 4 dB and a gain of 28 dB driving a cable with 7 dB loss looks like a preamp with an NF of 4 dB and a gain of 21 dB.

A good preamp at the antenna terminals can also improve the sensitivity of a mediocre receiver. To improve the situation, the noise figure of the preamp must be lower than the receiver's noise figure and the equivalent preamp gain must be greater than one. Good VHF receivers have noise figures in the 3 to 6 dB range, while excellent GaAsFET preamps have noise figures in the range of 1 dB and provide gains of 20 dB. Consider a receiver with a noise figure of 6 dB (F = 4), 7 dB cable loss (G = 0.2), and a preamp with a noise figure of 2 dB (F = 1.6) and 15 dB of gain. The equivalent gain of the preamp is 8 dB (G_1 = 6.3) and the overall noise factor with the preamp is:

$$F_{12} = 1.6 + 4 / 6.3 = 2.07 = 3.17 \text{ dB}$$

If the preamp's noise figure were 4 dB (F = 2.5), the overall noise factor would increase to 2.97 (noise figure of 4.7 dB). Without the preamp, the noise figure would be:

$$F_{12} = 1 + (4 - 1) / 0.2 = 16 = 12 \text{ dB}$$

The preamp reduces the overall noise figure from 12 dB to 4.7 dB, a significant improvement.

TV preamps or boosters from Radio Shack™ are not very expensive and can overcome long cable losses at VHF and UHF. For example, RS #150-1960, Cable TV Amplifier, at this writing under $30, has a bandwidth of 54 to 500 MHz, an NF of 6 dB, and a gain of 20 dB. This VHF/UHF preamp in front of a 6 dB receiver and 7 dB of cable loss offers a noise factor of 4.13 or noise figure of 6.16 dB. Without the preamp, the noise figure would be about 16 dB. Again, a worthwhile improvement.

HF receivers are usually spec'd as the input signal required to produce some output signal-to-noise ratio (S/N). An HF receiver whose sensitivity is specified as 0.5μV for 10 dB S/N in a 2 kHz bandwidth from a 50 Ω source can be converted to an equivalent noise factor. The 10 dB S/N implies an S/N of 3.16:1 or 0.5 μV of signal to 0.16 μV of noise at the input. The equivalent noise power E^2/R at the input is 5.12^{-16}, while the thermal noise kTB is 8.28 x 10^{-18} for a 2 kHz bandwidth. The receiver's internal noise is about 62 times greater than thermal noise, and the noise figure is about 18 dB. A VHF receiver with a noise figure of 18 dB would be considered a clunker, but that figure's not too bad for an HF receiver. In the 40-meter band the man-made noise is some 40 or 50 dB greater than thermal noise, so a receiver noise figure of 20 dB does not limit sensitivity. At 10 meters, the situation is quite different. Man-made noise and atmospheric noise are about equal to thermal noise, and the receiver's internal noise does limit sensitivity. From this it can be concluded that a low-noise preamp can be beneficial at 10 or 15 meters, but below 20 meters the improvement in sensitivity is negligible.

In fact, a preamp's gain is no advantage below 20 meters. A preamp can increase the signals at the input of the

receiver, true enough, but these higher signal levels are more likely to overload the receiver and generate distortions that appear as false in-band signals. Of course, a step attenuator in front of the receiver can negate the preamp's effects as if the cable losses were increased. A resistive attenuator is recommended over gain control of IF or RF stages in the receiver because the attenuator is passive, linear, and located at the lowest signal point. Many HF receivers have a switched 20 dB attenuator at the input to ease the overload potential. The attenuator actually increases the dynamic range; the maximum signals the receiver can handle don't change, but the minimum signals are reduced to near the receiver's internal noise, so the ratio of max to min increases.

The step attenuator shown in **Fig. 1** has three 10 dB steps, for a total of 30 dB. The resistor values for a 50 Ω step attenuator are given in **Table 1**. For a 75 Ω attenuator, multiply the values given in **Table 1** by 1.5. Of course, additional attenuator sections or different attenuations can be used if desired. The maximum attenuation that can be obtained in one step is determined by the capacitive coupling across the switch contacts. With ordinary DPDT toggle switches, the maximum attenuation is less than 40 dB at 30 MHz. R_1 is the series resistance and R_2 is the input and output shunt resistance of any one attenuator section. An attenuator with a total attenuation of 30 dB maximum is probably adequate for most situations. If the attenuation is set so that noise can be comfortably heard with maximum receiver gain, you won't miss any signals and you'll have the maximum dynamic range.

Even good HF receivers often suffer from poor sensitivity on 10 and 15 meters; typical values are 0.25 µV for 10 dB S/N (12 dB NF). A moderate preamp can overcome the sensitivity shortcomings of a poor 10-meter receiver. For example, a preamp with a noise figure of 4 dB and effective gain of 20 dB can improve the noise figure of a receiver with a 16 dB NF to about 4.6 dB. That's like multiplying the number of elements in your beam by nine or 10.

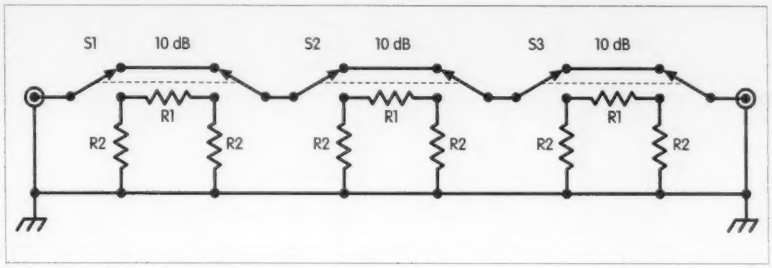

Fig. 1. *A step attenuator is a coarse gain control.*

A preamp can be built with discrete transistors or with hybrid amplifier modules such as the Motorola MWA110. While a preamp using a 2N5460 JFET can have a spot noise figure as low as 1 dB up to 400 MHz, obtaining a broadband match without introducing excessive losses is a challenge. There is much to recommend the MWA110 hybrid amplifier: wide bandwidth, respectable noise figure, and 50 Ω input/output resistance. The inherent stability of the hybrid modules makes possible the cascading of two or more units without oscillatory problems. An MWA110 is specified to have a bandwidth from DC to beyond 400 MHz, a gain of 14 dB, an NF of 4 dB, and 50 Ω input and output resistances. The 4 dB noise figure isn't great, but it's not bad considering the bandwidth. Two MWA110s in cascade have an overall NF of 4.1 dB and a gain of 28 dB. When a two-stage preamp made with MWA110s precedes a receiver with a 16 dB noise figure, the overall noise figure is about 4.3 dB. At 2 meters, where line losses are 7 dB and the receiver's noise figure is probably less than 10 dB, the overall noise figure improves to 4.2 dB or better.

The internal circuit of the MWA110 and the schematic of a single-stage amplifier are shown in **Fig. 2**. At VHF and above, the input/output impedance levels are most easily preserved on a circuit board by using 50 Ω microstrip transmission lines. **Fig. 4** is an example of a two-stage MWA110 amplifier which uses microstrip lines in conjunction with other sound RF construction techniques.

The construction of VHF circuits need not be difficult or magical if you keep in mind that parasitic capacitance and inductance accompany every component, and that the resistance of conductors is increased by skin effect. These effects must be accounted for—ignore them at your peril. The parasitic capacitance and inductance are independent of frequency but, of course, their reactances are dependent on frequency. For example, a one-inch piece of #20 AWG copper wire has an inductance of about 20 nH; at 400 MHz, that's an impedance of about 50 Ω. The lead inductance of capacitors and their capacitance makes an effective series-resonant circuit: A 0.01 µF disc ceramic with half-inch leads resonates at about 10 or 12 MHz; with sixteenth-inch leads, it resonates at about 30 MHz. A strip of copper has lower inductance than a round wire: A one-inch-long copper ribbon a quarter-inch by two thousandths of an inch (the cross section area of #22 AWG) has an inductance of about 12 nH. Skin effect

Continued on page 22

Atten.	Shunt Arm	Series Arm
dB	R2 (ohms) *	R1 (ohms) *
3	294	17.8
10	95.3	71.5
20	60.4	249
* nearest 1% values		
dB	R2 (ohms) **	R1 (ohms) **
3	300	18
10	100	75
20	62	240
** nearest 5% values		

Table 1. *Resistor values for a 50 Ω step attenuator.*

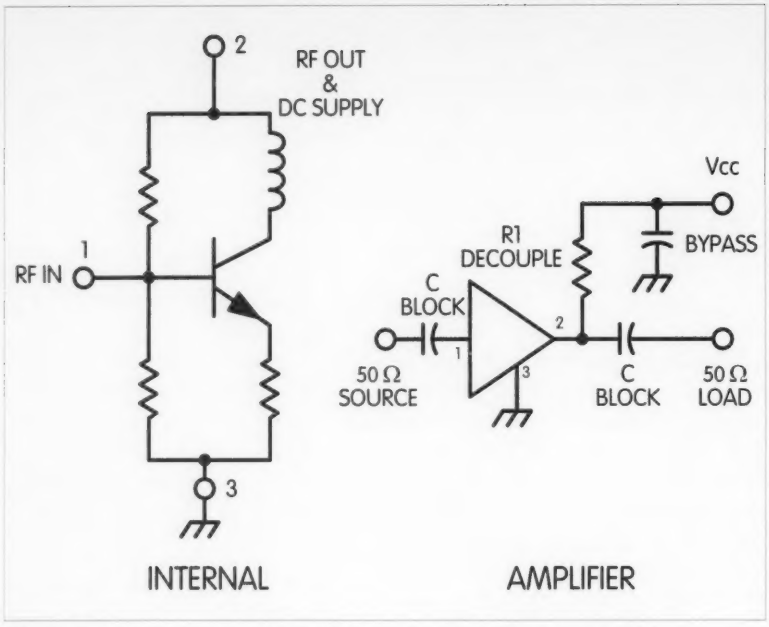

Fig. 2. The internal circuit of the MWA110 and its application as an amplifier.

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continued from page 21

increases the resistance of a conductor when the conductor's inductance crowds the current to the outermost surface of the conductor so that the current-carrying cross-sectional area is decreased and the resistance increased. Skin effect is a function of frequency, permeability (μ) of the conductor, and the conductivity (σ) of the conductor. The critical depth δ where 63% of the current is concentrated is:

$$\delta = \sqrt{(1 / 2\pi F\sigma\mu)}$$

where
δ = critical depth in meters
F = frequency in Hertz
μ = permeability in Henrys per meter (for copper, μ is 12.56×10^{-7})
σ = conductivity in Siemens per meter (for copper, σ is 58×10^{6}).

These skin effects lead to DC ground not necessarily being RF ground. At RF, a ground plane should be used as opposed to a ground point. A ground plane is by definition a plane in which all points have the same potential: The inductance and resistance between two points on the ground plane is zero. At DC or low frequencies, the inductance or resistance of a wire can be essentially zero and a point can be the reference ground.

The power gain of the MWA110 is 14 dB when device current is 10 mA and V_D is 2.9 V. When V_{cc} is 12 V, the decoupling resistance R_1 in **Figs. 2** and **3** must drop 9.1 volts. Therefore, R_1 must be 910 Ω. The amplifier shown in **Fig. 3** uses 50 Ω microstrip lines at the input and output of the MWA110. The DC components are on the ground plane side of the board, while the RF components are on the other side. The DC blocking capacitors C_1 isolate the amplifier from DC voltages on the input and output. C_1 and the 50 Ω input resistance act like a high-pass filter whose low cutoff frequency is $1/2\pi 50C1$. When the C_1s are 220 pF, the low-frequency cutoff is 14.4 MHz; when the C_1s are 1000 pF, the low frequency cutoff is below 3.5 MHz. C_1 is a leadless 220 pF chip capacitor similar to Kemet p/n C0805C221J5GAC. C0805C102K5RAC can be a 1000 pF chip capacitor C_2 that bypasses the higher RF current in R_1 to the ground plane. C_3 is a 0.01 µF chip capacitor similar to Kemet C0805C103K5RAC that bypasses the lower frequency currents in R_1 to the ground plane.

Each C_1 causes the power gain to fall 3 dB per octave below the cutoff frequency, 6 dB per octave. When all three C_1s are 220 pF, the response is down 9 dB at 14.4 MHz and down 18 dB at 7.2 MHz. Man-made noise rises about 20 or 30 dB in that octave. The increased noise and falling preamp gain will just about cancel out, and noise to the receiver will remain about the same. The resistors R_1 are 1/4 W carbon composition equivalent to MIL R-11 RC07GF911J. The R_1s are mounted on the RF side of the circuit board between the microstrip near pin 2 to the V_{cc} patch. R_1 should be dressed down on the circuit board and soldered to the microstrip and the V_{cc} patch. Throughholes are not needed. L_1 and L_2 are Ferroxcube shielding beads 56-590-65/4A on #26 AWG wire. L_1 is a single turn and L_2 is two turns.

In passing, note that every pass of the wire through the bead's hole is one turn. The circuit board is one ounce (0.0014 inches thick) double-sided copper on 0.0625-inch Fiberglas™ epoxy (dielectric constant of 5), with the top side, which would normally be the component side, being the ground

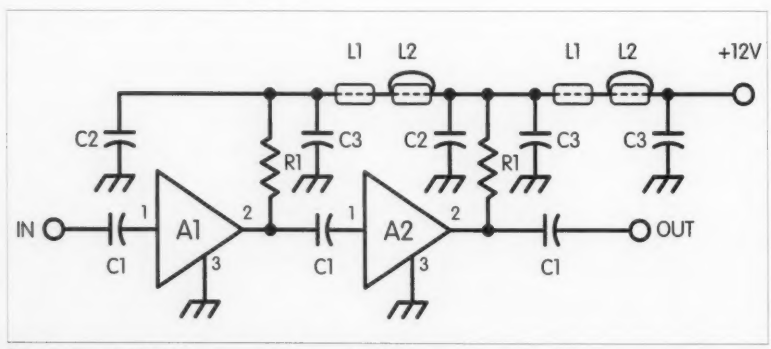

Fig. 3. Two MWA110s produce a broadband preamp.

plane. The ground plane is continuous except for reliefs around pins 1 and 2 of the MWA110s and around the through-holes for L_1 and L_2. The bottom (track) side is the RF side. The top and bottom ground areas are interconnected with #20 AWG hairpin-shaped "U" bars soldered to both top and bottom ground areas. Of course, plated-through holes can be used instead of "U" bars. The number and location of the "U" bars is not particularly critical, but prudence indicates their use near pin 3 of the amplifiers, the bulkhead connectors, C_2, and C_3 to ensure that the ground areas are all at the same potential. The inductance of a "U" bar is about 0.2 nH, and its reactance is less than an ohm even at 400 MHz.

The characteristic impedance Z_o of the microstrip lines is a function of the circuit board's dielectric constant, thickness, and conductor width. A Z_o of 50 Ω is obtained with one-tenth-inch conductor widths on the 0.0625-inch circuit board. The width of the striplines is critical, but not the length. Sharp bends in the lines can introduce discontinuities in the impedance and are better avoided. The MWA110 is mounted snugly down against the ground plane side of the board, and through-holes pass the leads through the ground plane to the microstrip. The case of the MWA110s is connected to pin 3 and may make contact with the ground plane, but it need not be soldered.

The schematic of a two-stage preamp using MWA110s is shown in **Fig. 3.** It is very much like the amplifier shown in **Fig. 2**, except for the decoupling in the V_{cc} line. **Fig. 4** shows the stripline and the physical layout of the circuit board; the scale is approximately 2:1.

Continued on page 24

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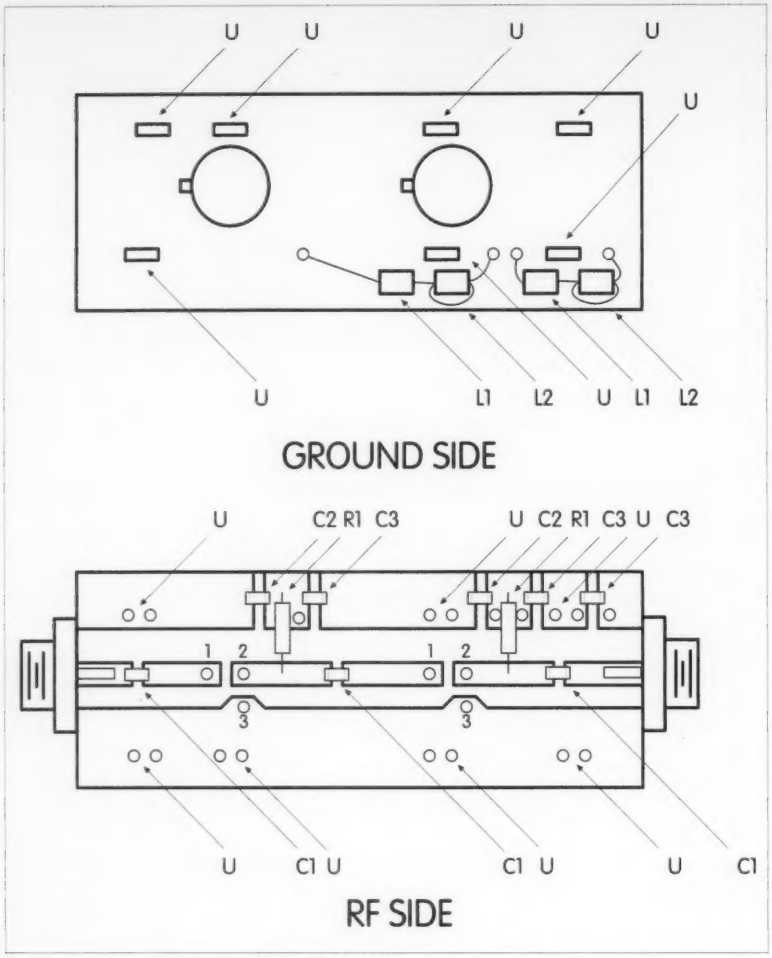

Fig. 4. A two-stage amplifier can be built in stripline.

Sensitivity Training
continued from page 23

When the amplifier modules are spaced an inch or so more apart, no interstage shielding should be necessary. The preamp board should be mounted in a shielded box and the length of the circuit board made long enough to fit between the center pins of the bulkhead connectors. The flanges of the bulkhead connectors should be soldered to the ground areas of the circuit board.

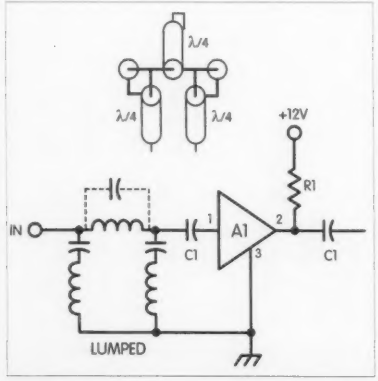

Fig. 5. A notch filter can reduce interfering signals.

The shield box is necessary to protect against the weather and extraneous signals that might be picked up. Note that the enclosure can look like a waveguide or cavity and support waveguide coupling between the input and output as well as provide a means of undesired feedback. The coupling is not likely to be tight enough to be a problem if the connector center pins are soldered directly to the stripline and the decoupling resistors R_1 are dressed against the circuit board. +12 V should be introduced to the circuit board at the output end of the board. The board is light enough to be supported by the center pins of the connectors and no extra mounting support should be needed for fixed installations. When used in a high-vibration environment, some extra support may be needed.

The advantages of a preamp at VHF and UHF are apparent when there are high transmission line losses or when the receiver's noise figure is high. The broadband preamp described can be used for all bands up to 440 MHz without band-switching. If there is a strong FM or TV signal to contend with, a notch filter will be required in front of the first stage to knock the big interfering signals down to tolerable levels. The filter shown in **Fig. 5** can be made in coax between the antenna and the preamp or with lumped constants on the circuit board. The input impedance of a quarter-wave transmission line is an open circuit when the output end is shorted, and is a short-circuit when the output is open.

A typical lumped-constant filter is shown in **Fig. 5**. The tuned circuits resonate at the frequency of the interfering signal. For frequencies below 150 MHz, the quarter-wave lines are longer than 19 inches. For lower interfering frequencies, lumped constants are more appropriate. The inductor for the parallel-tuned circuit can be wound on a 1/4 W 10 kΩ resistor used as a coil form. Ideally, the inductor of the parallel-tuned circuit is self-resonant at the frequency to be rejected, and the shunt input and output series-tuned circuits are series-resonant capacitors. If wound coils are used, their axes should all be mutually perpendicular.

Most HF receivers don't shine at 10 and 15 meters, and a preamp can help there. But below 20 meters, the extra gain is no help and can actually be a hindrance. In the preamp shown, the gain below 20 meters is reduced by the DC blocking capacitors C_1. When the C_1s are 220 pF, the preamp gain begins to roll off at about 14 MHz where the extra gain is no advantage. A receiver's sensitivity can be improved with the judicious application of a low-noise preamp. The key word is judicious. Mae West wasn't talking about preamps when she said, "Too much of a good thing is just enough." 73

Joy's "Loud Enough" Metronome, Part 2

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Last time, you'll recall, we went through the story of why I decided to build a metronome that my daughter could hear over the sound of the piano—one that could be set for any beat. Part 1 included the schematics and parts lists: now let's put it together.

Note: **Figs. 1–5**, **Tables 1–3**, and **Photo A** were all included in Part 1, published in April's *73*.

Fig. 3 (remember it from last time?) lends itself to just about any type of construction that's agreeable to you. **Photo B** shows the interior of the basic bare-bones, blue-box metronome, with eight presets. An inexpensive card file box comfortably houses the parts. This particular model has eight presets plus the adjustable tempo control. It uses a piece of perfboard to hold the main part of the circuit. The second piece of perfboard holds the adjustable and fixed resistors for the preset times. I mounted it on the back of the preset switch.

Mounting the board by its leads avoided the problem of having to run a small bundle of wires. You could put the entire circuit on a single piece of perfboard. You may want to start by putting the 7805 regulator on the board and then the protection diode. Without that diode, turning off the power would allow C3 to discharge back through the regulator, destroying it. If you use the preregulator of **Fig. 5(a)**, you will not need the protection diode.

Following that, put on the capacitors and the resistors. Then run the wires from the board to the various controls and to the LED.

Hot LED?

You may wonder about the value I picked for the current-limiting resistor for front-panel LED1. Normally, you would subtract the 1.2–2 volts dropped in the LED from the supply voltage. Then divide that by the current you want in the LED.

We can look at a quick example. 9 V – 1.8 V = 7.2 V. The series resistor will have to drop 7.2 volts at 10–15 mA (0.01–0.015 amps). Using 12 mA and dividing that gives a resistor of 600 ohms. The nearest standard values are 560 and 680 ohms.

In a normal circuit, that would work. But, remember, this is a pulse circuit. The pulse, *tock*, lasts only four milliseconds (0.004). Although the LED can respond to pulses many times shorter than that, it does not give off a

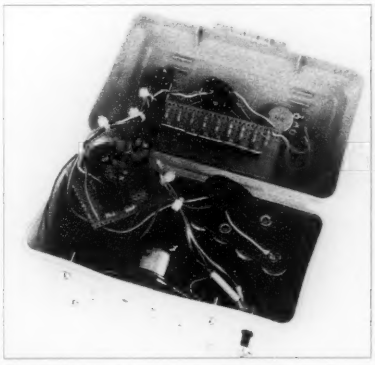

Photo B. *Inside a basic, bare-bones, blue-box metronome with perfboard construction and eight preset tempos. A close look at the battery pack will show a tap, one way to get the correct voltage to Q1 and Q2 before trying the regulators. This does work while the batteries are fairly fresh. However, it does not give the best repeatability—sometimes that is a consideration.*

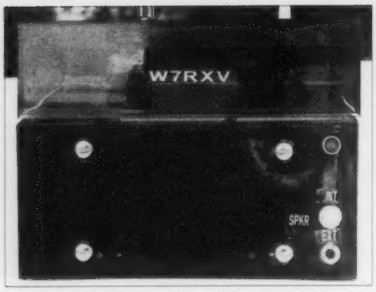

Photo C. *Metronome in better-grade card file box, showing results of taping graph paper to box for layout. LED1, upper right, flashes in step with* tocks, *or silently if INT/EXT speaker switch is set for EXT and no external speaker is connected.*

useful amount of light under these conditions. So, with the nominal 47–68 ohms that I used, it gives off a good light. And the LEDs have survived the short, but large, current pulses.

Another way

Photo C shows another way to build the circuit. It uses a better-grade card file box and shows the results of taping a piece of graph paper to the front of the box. This gave evenly spaced marks for drilling the holes—unlike **Photo D**, the deluxe version with 36 presets, which needed a grill to cover the irregular holes in the box. This metronome without presets, **Photo C**, has the simple three-volt regulator.

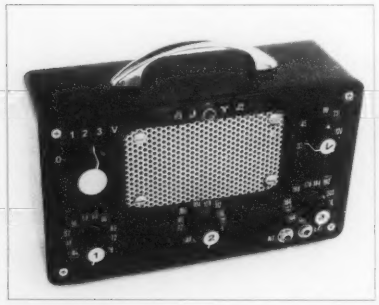

Photo D. *Deluxe version of "loud enough" metronome has 36 preset tempos plus variable control. Small LEDs next to the switches and variable control give a dim but visible reminder of which one you selected. Note one LED to the left of the "V" knob for the variable control, and three others to the left of presets knobs 1, 2, and 3, underneath the numbers 44, 88, and 144, respectively.*

You may choose to make a PCB layout with tape, as I did for the unit in **Photo A** (Part 1), or to make your unit with perfboard, in which case **Photo B** might be of help.

Box layout

Once you have picked up the parts, you may want to lay out where the controls will go on the box. The photos suggest a layout for the various versions, theme and variations, if you will. Here again, a piece of graph paper taped to the top or to the front of the box can be most helpful. Either the common four-squares-to-the-inch or the 10-squares-to-the-inch kind works well. Pencil in what you want and where you think it should go. Putting it in pencil on the paper makes it easy to make changes. When you settle on a layout, start drilling.

The hard plastic card file box drilled without too much danger of cracking. However, I did use a small drill for pilot holes just to stay on the safe side. While you can get other card file boxes at supermarkets or variety stores, you will probably have to go to an office supply store for a better-grade box. Although it costs about double what the other box does, it did get favorable comments from Joy. Besides that, my wife even let me decorate the piano with this one!

Less decorative

Although these metronomes give a good, loud *tock*, they will give a much louder sound when you plug a larger speaker into them. Most of us like the smaller, more portable unit. However, you can just build the electronics into a larger speaker box. That would make a pianotop or desktop model.

We found that a six-inch speaker gave more than enough sound for a flute quintet to use during a practice session, notwithstanding the conductor's apology for the noise.

When you finish the box, you will have an idea of how many wires will go from it to the board, and about how long to make them.

Check-out time

When you finish the board and have run wires to the speaker, the tempo control, and the battery, you can run a quick test. Before hooking up a battery, double-check to see that the voltage regulators and the transistors are wired properly. Also, double-check the timing capacitor, C2. You want the plus side of the capacitor to go to the base of Q1 and the minus side to the collector of Q2—not to common.

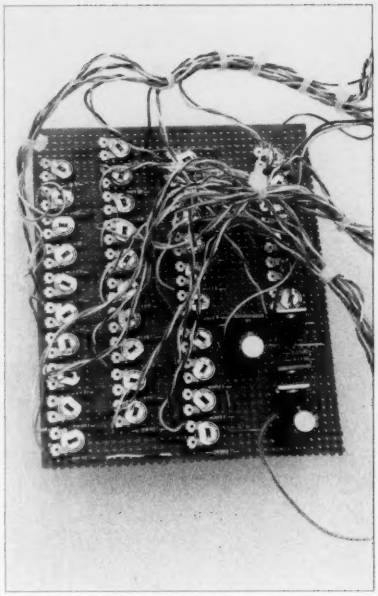

Photo E. *Overall view of board in deluxe model. The regulator and pulse generator are on the lower right side of the board, while the fixed resistors and their trimmers take up the rest of the space.*

Metronome Marks		
40	92	152
44	96	166
48	100	168
52	104	176
56	108	184
60	112	192
63	116	200
66	120	208
72	126	214
78	132	220
84	138	226
88	144	238

Table 4. *Metronome marks.*

Metronome Marks	Period
40	1.5
46	1.3
52	1.15
60	1.0
66	0.909
72	0.833
78	0.769
84	0.714
90	0.667
96	0.625
102	0.588
108	0.555
114	0.526
120	0.5
126	0.476
132	0.4545
138	0.435
144	0.416
150	0.4
156	0.385
162	0.37
168	0.357
172	0.349
178	0.337
184	0.326
190	0.316
196	0.306
202	0.297
208	0.288
214	0.28
220	0.2727
226	0.265
232	0.258
238	0.252
244	0.246
250	0.24

Table 5. *Metronome marks and periods. To get period, divide the metronome mark into one and multiply by 60. One divided by 40 = 0.025. Then, 0.025 x 60 = 1.5. Adjust the trimmer so that the counter, in the period mode, reads 1.5. If your teacher likes other marks, use those.*

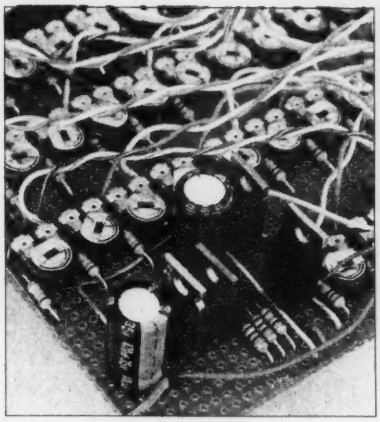

Photo F. *Close-up of board in deluxe model. Large caps are C3 and C4. Transistors Q1–Q3 are seen left to right in a row, with the 7805 regulator above Q3.*

Connect a wire from the battery plus, 9 V for the first test, to the *input* of the 7805 or the LM317. Connect the minus to the common line. If you have a multimeter with a nominal 300 mA range, connect it between one side of the battery and the circuit. The LED, the speaker, or both should give pulses. If they do not, but the meter does, or the meter shows a high, steady current, remove the battery leads and recheck the wiring. If the meter pulses, check the wiring to the amplifier stage.

Remember, the LED will light only if it has the plus side going to the battery plus. Normally, the longer lead is plus on the LEDs. You may connect a 1000–4700-ohm resistor, the LED, and a nine-volt battery in series to verify the LED connections. Although you can solder directly to the LED wires, I usually take a couple of pins out of a machine-pin IC socket and use them for the connections. That makes it easier to get the wires on the right way.

Calibration

Once you have it ticking, you will want to calibrate your metronome. You can use the tried, true, but tiring method. That means count the pulses

Continued on page 80

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CIRCLE 114 ON READER SERVICE CARD

The Taylor Vee 20m Antenna

"Anything you don't understand must be magic!"

T.L. Poindexter WA5NPQ and
Singleton C. Taylor KB5IAY
8325 Wasson Road
Shreveport LA 71107

This antenna was designed by Singleton Taylor KB5IAY, as an effort to solve two of the most common shortcomings of simple low-cost antenna systems for 20 meters: lack of real estate and difficulty of SWR adjustment. There was another fairly serious design constraint, as well, readily understood by most hams—limited hobby funds.

The antenna was designed as an inverted vee, allowing it to fit into an available side yard, among several other antennas already in place. The inverted vee is a standard dipole antenna, with the ends drooping down from the center feedpoint.

Since dipoles have somewhat directional antenna patterns, with maximum radiation at right angles to the plane of the conductors, fairly deep nulls exist off the ends of the antenna. This was addressed by mounting the antenna on a PVC pipe framework, and using a light-duty Radio Shack™ TV antenna rotator to rotate the entire assembly.

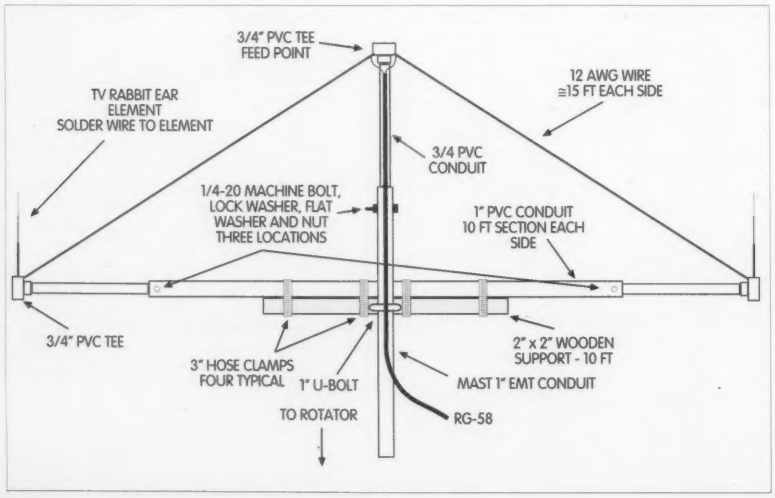

Fig. 1. *The Taylor Vee (drawing not to scale).*

Build simply

The entire assembly is mounted upon a five-foot piece of two-inch EMT conduit, driven about three feet into the ground. See **Fig. 1**. The main vertical support is a single 10-foot joint of one-and-one-quarter-inch EMT conduit, slipped inside the two-inch EMT ground support.

The Radio Shack rotator is mounted at the top of this conduit. The entire antenna assembly support framework is then mounted to the rotator.

The vertical support for the center feed of the antenna is a 10-foot joint of one-and-one-quarter-inch EMT conduit, clamped into the rotator. The top of this vertical support is split for about six inches, and a single joint of three-quarter-inch PVC conduit is slip-fitted into the joint and clamped with pipe clamps to extend the vertical support an additional three or four feet.

A three-quarter-inch PVC tee is mounted at the top of this three-quarter-inch PVC extension. It becomes the support for the antenna feedpoint.

Parts List

Qty.	Description
2	1" PVC pipe, 10-ft. length
1	3/4" PVC pipe, 10-ft. length
1	2" x 2" wood, 10-ft. length (crossarm)
1	1-1/4" U-bolt
4	Hose clamp to secure PVC pipe to crossarm
2	5/16" x 1" machine bolts with nuts
3	3/4" PVC "T"
1	Light-duty TV rotator (RS# 15-1225)
50 ft.	Rotator cable, 3-conductor (RS #15-1149)

scrounged rabbit ear antenna

1-1/4" EMT conduit for mast, length dependent upon height

#12 AWG THHN antenna wire (approx. 30 ft. required for 20 m antenna)
Total length of antenna = #12 AWG + rabbit ear extensions.
L = 468/freq in MHz.

Table 1. *Parts list.*

Just above the rotator, the horizontal support is mounted to the one-inch vertical EMT conduit. The horizontal support is formed of two joints of one-inch PVC conduit, joined by a PVC coupling. This, in turn, is supported by a 10-foot section of 2 x 2 lumber, U-bolted to the vertical pipe. The one-inch PVC is secured with hose clamps to the 2 x 2 horizontal support in four places.

The horizontal support is further extended by slip-fitting a three-foot section of three-quarter-inch PVC pipe into each end of the one-inch PVC horizontal support and gluing a PVC tee onto each end of this three-quarter-inch PVC horizontal support, with one port pointing up. The tees are the attachment points for the antenna ends, and mounting for the VSWR adjustment elements. The three-quarter-inch PVC extensions, with the PVC tees attached, are secured into the one-inch horizontal supports by one-quarter-inch bolts through holes drilled through both PVC pipes.

Details, details ...

The basic antenna is built from 12 AWG THHN insulated electrical wire, available at any hardware store. The drooping radials are attached to each side of the PVC tee, mounted at the top of the vertical support, and the coax feedline is soldered directly to the antenna elements. Since only low-power (100 W) operation is envisioned, RG-58C/U is employed as feedline. The antenna conductors are attached by drilling holes through the PVC tee, and looping the antenna conductor through the hole, before soldering. No matching transformer or balun was used, as impedance of the feedline (52 ohms) was close enough to the anticipated feedpoint impedance.

The drooping ends of the radials are secured to the PVC tees at the end of the horizontal supports with electrical tape. The length of each side was cut to approximately 14-1/2 feet, with the remainder of electrical length (approximately 16-1/2 feet total, depending upon desired frequency of operation) to be made up by the adjustable VSWR elements mounted on the ends of the antenna. The elements droop at about 34 degrees, for no particular reason other than the space available.

Adjustable VSWR elements

In order to adjust the electrical length of the antenna, adjustable elements were improvised from rabbit ears salvaged from an old TV set. One of the sliding elements was mounted at each end of the horizontal support, and the antenna conductor was soldered to this element.

A short section of wooden dowel was driven into the top end of each of the PVC tees mounted at the ends of the horizontal support. A vertical hole (to fit) was drilled through each dowel, and the rabbit ear element was pushed through the hole and glued into place. The antenna conductor was then soldered to the bottom end of the element, allowing easy adjustment of antenna electrical length (VSWR), without having to drop the entire antenna assembly.

Must be magic

Hams who have used this antenna claim it outperforms a conventional

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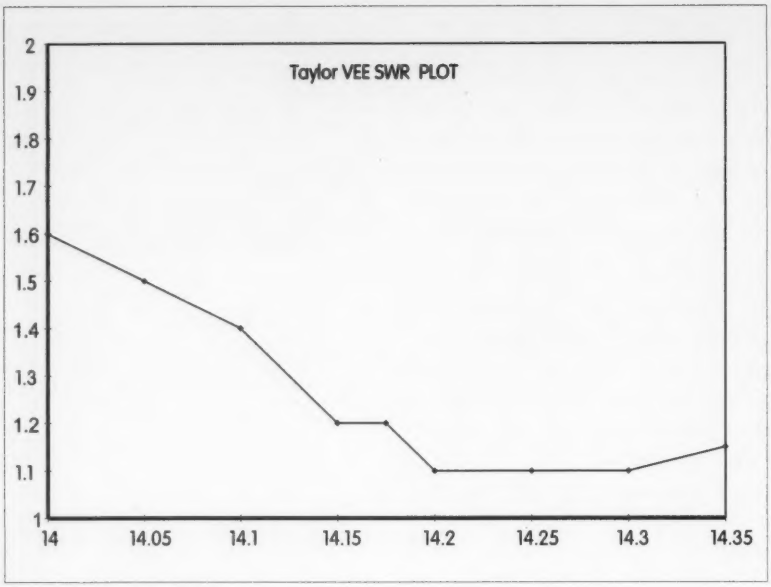

Fig. 2. *Taylor Vee SWR plot.*

dipole, under similar conditions. In an effort to better understand this apparent performance improvement, some rudimentary testing was done of both VSWR and radiation pattern.

VSWR was measured across the entire 20-meter band, and proved to be usably low across the entire band, with near-perfect match in the phone portion of the band. Due to the adjustable elements, this was easy to shift in frequency. The wide VSWR bandwidth was a pleasant surprise. No VSWR testing was done outside the 20-meter band limits. See **Fig. 2.**

A simplistic measurement of a single point received signal was made, to roughly determine the radiation pattern of the antenna. An IFR-500 service monitor was used as a signal source, and the station transceiver, a Kenwood TS-440, was used in receive mode to measure strength of received signal vs. antenna orientation. Signal strength was adjusted to give nominal mid-scale S-meter readings. S-meter readings were recorded vs. antenna position, and plotted to represent antenna pattern.

Because of the design of the antenna, with drooping radials, and vertical VSWR adjustment stubs at the ends of each element, it was decided that any assessment of correct polarization would be a wild guess, so we opted to use a transmit antenna (IFR-500) aimed at about 45 degrees above the horizon as a "best guess" compromise.

Antenna boresite was determined, using the MK1 Mod 0 eyeball, by setting the antenna element perpendicular to the line to the IFR-500. The signal source was located several hundred feet away, to avoid near-field effects.

The antenna was rotated in approximately 15-degree steps around the signal source direction, and S-meter readings were recorded at each step. The azimuth indicator on the rotator was used for direction readings, which were quite coarse.

S-meter readings were converted to dB, relative to boresite amplitude, and recorded vs. direction. No calibration of the receiver S-meter was done, and we assumed 6 dB per S-unit. After recording, these readings were input to a C++ program, part of a radar antenna modeling software package developed by WA5NPQ for Wright Labs, and expanded to 4096 points. The points entered were extrapolated by software, by using the current point measured, the last point measured, and the next point measured, and applying a curve-determining algorithm to determine the approximate value of the intermediate points.

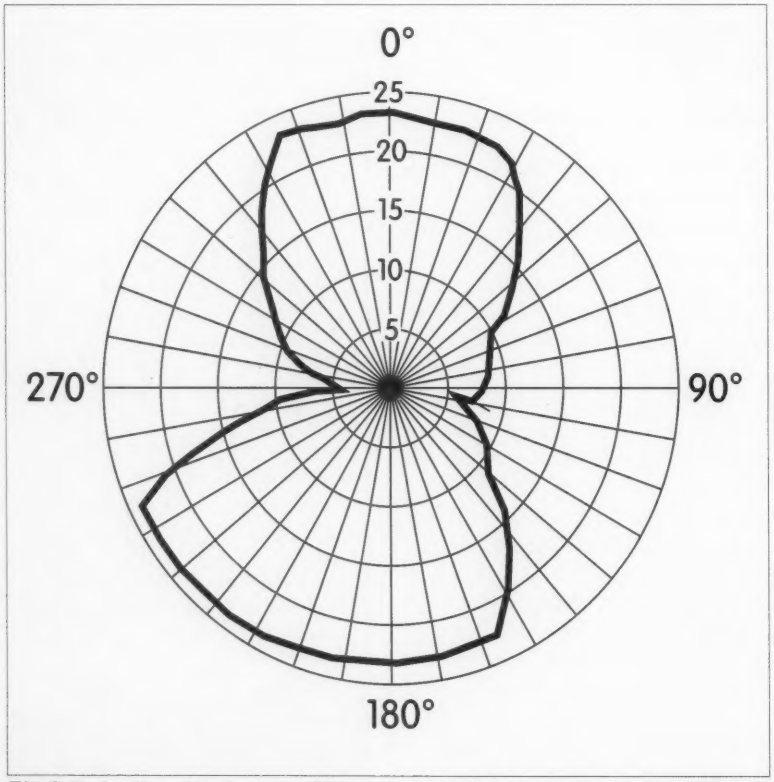

Fig. 3. *Taylor Vee azimuth pattern. Units are relative field strength in dB. Antenna plane lies on 270-90 degree line.*

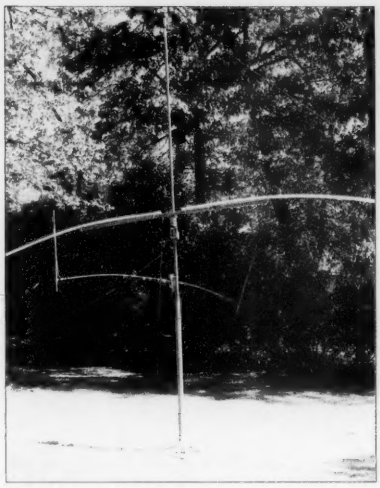

Photo A. *"If it ain't broke, don't fix it."*

The resulting data was imported into Microsoft Excel®, and plotted as a circular (radar) plot (**Fig. 3**). The resulting plot essentially follows the classic expected dipole characteristics. There are some discontinuities, due to the rough measurement techniques. In addition, some distortion is present, and can probably be attributed to current unbalance in the feed (no balun used), to errors in boresite angle determination (MK1 eyeball calibration), and to errors in angle measurement (Radio Shack azimuth indicator).

Getting there for less

Using ingenuity and a minimum outlay of bucks, the designer ended up with an antenna which fits his available space, is easily adjustable for VSWR, and can be rotated, so no nulls are present. Using only the TS-440 barefoot, he is able to hold his own in the DX quest. He has been able to work as far as Australia and the Cape Verde Islands fairly consistently, working VK6ACY and others on multiple occasions, with very favorable signal reports. Medium and short skip has also been consistent, with excellent results. Why does it work so well? We're still not sure. An entire afternoon of measurement did nothing to improve our understanding. However, we're sticking to two widely accepted engineering maxims: "If it ain't broke, don't fix it!" and "Anything you don't understand must be magic!" 73

NEVER SAY DIE

continued from page 5

Only about 22% of all amateurs are ARRL members, with the trend being toward us old-timers over 50.

The ARRL Board of Directors is loaded down with old-timers like NM7N (71), W4RH (73), WA6WZO (60), and W9PRN (85). Other officers are NØBCI (89), KØTO (66), W6CF (65), and N4MM (61), so perhaps it's no wonder that the League seems to be almost totally out of touch with the bulk of today's hams.

Looking at the results of the last board meeting, I notice that a proposal to increase HF privileges for Novice and Tech-Plus licensees was quickly voted down. Figures. They also rejected a proposal even to study the feasibility of reducing the number of license classes. I've been proposing for years that we have one class of license.

Fellow League members, do you recall ever being asked your opinion on these matters? I know I never have been.

The board decided to push the FCC to better enforce our rules so we won't have to listen to so much bad language on the HF bands. And that, of course, means that the League is going to pressure the FCC to allocate more money to policing our bands — something which I feel we should be doing ourselves. One of the things we've often bragged about is being self-policing. So here we have a government bureau which has been cutting back and auctioning off parts of the spectrum and we're demanding that they spend more money on us because we are unable to keep control of ourselves. Could this demand for more services prompt the commissioners to question the relevance of amateur radio in today's world?

I didn't see anything in the board meeting report about the ARRL initiating any efforts to clean up the mess some of our older hams are making of our HF bands. Every time I bring this up I get accused of League bashing. Well, as a member, I feel it is the responsibility of my organization to help keep our bands clean. The League should also be making a maximum effort to attract new hams. Instead, I get the overwhelming impression that the powers that be at the League are more intent on keeping QRM down by limiting, as much as possible, the number of hams on HF.

The board agreed to push the FCC to establish the League band plans as part of their official regulations. Talk about a power grab! Leaping lizards! Do you agree with this social engineering move?

Heck, our present band plans don't reflect our current use of the bands. We have wide open and virtually unused CW bands, which fewer than 10% of us who are active are using with any regularity, and crowded phone bands for the other 90%. Considering the channel space required for CW vs. phone, the plans are all the more inequitable.

Somehow I'm reminded of the National Computer Conference, which put on computer shows every year. The shows had hundreds of exhibitors and drew over 100,000 attendees. But they, like the rest of the mainframe and minicomputer industry, ignored microcomputers. Today most of the mainframe companies are out of business and the minicomputer companies about gone, too. I loved it when Compaq bought what's left of DEC. What has happened to Prime, Data General, Wang and the rest? The National Computer Conference blew away with the rest of the old computer industry.

Even the largest of organizations has to stay relevant or they're soon history. Will there be an ARRL in ten years? Will I be getting my 70-year pin? I expect to be around, but I'll be surprised if the ARRL is — unless they start wising up and making themselves relevant to the majority of the hams. Right now, at least 78% of the hams don't think the ARRL is relevant. If we count in the members who agree that some big changes need to be made, we might be pushing 90%. No wonder the directors aren't asking us our opinions and then reflecting them at their meetings.

FCC vs. the Constitution

The requirement in Article I of the Constitution that Congress make all laws has been ignored ever since FDR grabbed the reins 66 years ago. We've gradually gotten used to government agencies enacting legislation, and our blessed liberal courts have put up little resistance. If you go into court today and cite the Constitution to support your case, you'll get laughed out of court. Judges are making laws. Government agencies are making laws, and little of this is benefiting us.

Congress has remained silent while federal judges have usurped their power to levy taxes. Congress has remained silent because you have remained silent.

The latest power grab has been by the FCC. Yep, our semi-beloved benefactor has stuck its hand into the public pocket with a tax on telephone companies to finance Internet services for public schools and libraries. This tax will, of course, be passed along to you with higher charges. The phone companies wanted to at least

Continued on page 81

Penny Pincher's Digital Ammeter

Inexpensive, accurate, seaworthy.

Sam Ulbing N4UAU
5200 NW 43rd Street
Suite 102-177
Gainesville FL 32606

Because I do a lot of mobile ham operating, battery usage is very important to me. During the past few years, when cruising on my boat I have often found my battery voltage becoming lower than it should be. As a consequence, I have been told by the Waterway Radio and Cruising Club net controller that I was "FMing, check your batteries." (The Waterway Radio and Cruising Club meets daily at 0745 Eastern time for about an hour and is dedicated to helping and passing traffic for marine mobile amateurs primarily along the east coast of the US and in the Bahamas.)

To monitor my power use, I decided I needed a good ammeter. I wanted to monitor currents up to 100 amps but also to be able to tell the difference between currents in the 100-milliamp range. Obviously, for this accuracy and precision I would need a digital readout.

Unfortunately, the ammeters at the store were expensive ($65 or more). Worse, the readout was a vague analog device that would only tell me if I was using a lot or a little current. When I looked for digital ammeters, I found I would almost need to mortgage the boat if I wanted one! So I decided to build my own.

Generally, to measure large currents you use a low-resistance shunt and measure the voltage drop across it (**Fig. 1**). (For proper operation, the shunt resistance must be considerably less than the load resistance.) I found that shunts were also expensive, so I decided to build that as well.

The resulting ammeter has worked very well for me and I now know why I am running down my batteries. I talk on the ham rig too much! I solved my discharge problem by using

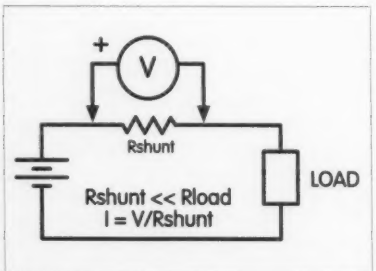

Fig. 1. *Using a shunt to measure current.*

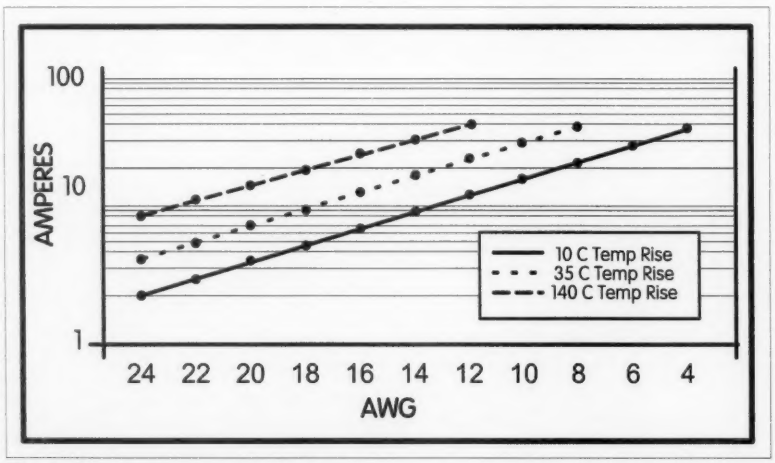

Fig. 2. *Current-carrying capacity of wire.*

the money I saved through "homebrew" to help buy a bigger alternator.

An inexpensive voltmeter

Excellent and inexpensive digital voltmeters are readily available at many surplus outlets [such as All Electronics, P.O. Box 567, Van Nuys CA 91408; (800) 826-5432]. These 3-1/2 digit meters sell for around $10 and run on 9 V. They come with nice faceplates, making it easy and neat to mount them. The meter consists of an A/D converter chip with built-in display driver (like the ICL7106), an LCD 3-1/2 digit display, and all the parts needed to make it work. A few years ago, before these surplus items came on the market, I had built one of these DVMs from scratch. Just for the parts, I spent twice what the complete meter now costs!

The meter, which uses only about three milliamps, comes with instructions for setting the maximum voltage range that you want to measure. A simple voltage divider will let you set maximum ranges of 2.000, 20.00 or 200.0 volts. If you do not add any resistors, the maximum range is 200.0 millivolts. This is the range that I used for my ammeter. (I also have one set for 20.00 volts max that I use to measure my battery voltage—but that's a different story.) Being able to use the meter without external resistors provides an accuracy advantage, since even 1% resistors have some error—but with no resistors, you get no voltage divider error!

These meters come with a built-in disadvantage that fortunately happens to be an advantage for this application. Due to the configuration of the meter circuit, the voltage source used to power the meter must be totally separate from the circuit you are measuring. This means I could not use the ship's 12 V system and a 9 V regulator to power it; I had to use a separate 9 V battery source. There are several ways to do this and each has advantages and disadvantages (see below). The good news is that, because the meter is on a floating power source, it has no problem measuring voltages above the maximum battery voltage—which it might if it were powered from the ship's power supply.

Making the shunt

You are probably saying, "Big deal—you use an off-the-shelf meter to measure a voltage and call it a project." But, of course, there is more. Having bought the digital voltmeter, I tried to locate a current shunt. I wanted to have 100.0 millivolts for 100.0 amps, which would let me read the current directly. A one-milliohm shunt would do the job, but I could not find a proper one

Continued on page 34

AWG	Ω per 1000 feet
0	.098
1	.124
2	.156
3	.197
4	.248
5	.313
6	.395
7	.498
8	.628
9	.792
10	.999
11	1.26
12	1.59
13	2.00

Table 1. *Wire resistances.*

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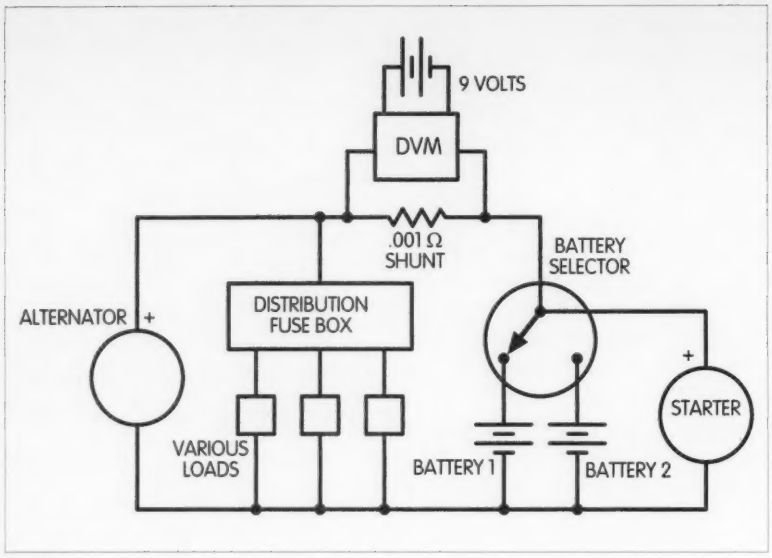

Fig. 3. *Connecting the ammeter to a "real-world" circuit.*

Penny Pincher's Digital Ammeter
continued from page 33

and the shunts I did find were $25 or more.

Fortunately, like many hams I am a pack rat. I recalled a chart I had received from a wire company a few years earlier. Believe it or not, I was actually able to find that chart, and on it was everything I would have ever wanted to know about wires (and even more!). One table gave wire resistance (**Table 1**), and I saw that 1000 feet of #10 wire had a one-ohm resistance (actually 0.9988)—so I could use one foot of it to get one milliohm.

But **Fig. 2** told me that I did not want to do that, since only 45 amps would raise the #10 wire temperature by 140° C (285° F.). By using these two tables, I decided that four feet of #4 gauge wire would work and not get too hot. This size wire is readily available at auto stores, Home Depot™, etc., and implementation was easy.

I coiled up the #4 wire to keep it compact, and soldered a small gauge wire (#18) from each end of the shunt to the voltmeter. I connected the shunt into my ship's power circuit as shown in **Fig. 3**. This circuit allowed me to measure alternator charging current (which is displayed as a positive voltage) and the current used by my radio, lights, etc., as a negative voltage. I chose not to put the starter motor in the circuit because, with its very large current draw, I would have had to use a lower resistance shunt and I would lose my resolution at the lower current levels. This basic design worked well but I was able to improve it further.

Trimming the shunt

Table 1 said the shunt would be one milliohm (a recent *QST* article—November 1997—gave slightly different values), but I suspected that not all wires are created equal and wanted to trim the shunt to be as close as possible to one milliohm. Unfortunately, my expensive ohmmeter does not go down to one milliohm. However, the $10 DVM I was using for the project has a voltage scale that is 200.0 mV full scale, so I could use a part of this project to align the rest of it (neat)! I also had some 0.47 ohm, 5 W, 10% resistors from Radio Shack™ and a 12-volt battery capable of delivering a lot of current with no significant voltage drop. With a battery voltage of 12.55 volts and three of the 0.47-ohm resistors in series as a load, there would be 8.9 amps through the shunt. I trimmed the shunt until it read 8.9 millivolts. It was important to do the measurements quickly because the power dissipation in the 0.47 ohm resistors was 35 watts, not five watts. Of course, the results would have been more accurate if I had used 5%, or better yet 1%, resistors.

[Note: The load resistance (Rload) for my measurement was 3 x .47 = 1410 milliohms and the shunt I was trimming was only one milliohm, so Rshunt << Rload. Other measurement errors include the meter accuracy of 0.5% ± one digit. Except for the 10% uncertainty of the load resistors, I could trim my shunt to about 2% accuracy. I have found that for larger currents I can get better readings using a known low value resistor and voltmeter than from using the ammeter feature of my DVM. This is because the ammeter often has a resistance that is fairly large compared to the load resistance. Further, the exact resistance of the meter is usually unknown, so it cannot be compensated for. For instance, when I placed the three 0.47-ohm resistors across the 12.55-volt source in line with my ammeter on the 20-amp scale, I read 7.05 amps instead of the calculated 8.9 amps. Using another voltmeter, I found that the voltage drop across the ammeter was 2.4 volts. While the documentation states that the "maximum voltage burden" of the meter is 900 millivolts, obviously all the connections increased the voltage drop through the measuring circuit. The uncorrected error using the ammeter would have been 20%, twice the error from using 10% resistors. So, basic as it is, this method can give good results.]

Powering the meter

A 9 V battery: The easiest way to power the meter is with a nine-volt battery. This method did not appeal to me, as I was afraid I would turn the meter on and forget to turn it off, quickly running down the battery.

Four NiCds: Rechargeable NiCd batteries seemed like a better power source, but nine-volt NiCds are scarce and expensive. If I used AA batteries to get nine volts, I would need eight cells: many batteries, much space and expensive. By building the circuit shown in **Fig. 4**, I was able to get nine volts from only four NiCds. U1 is a voltage inverter chip which produces

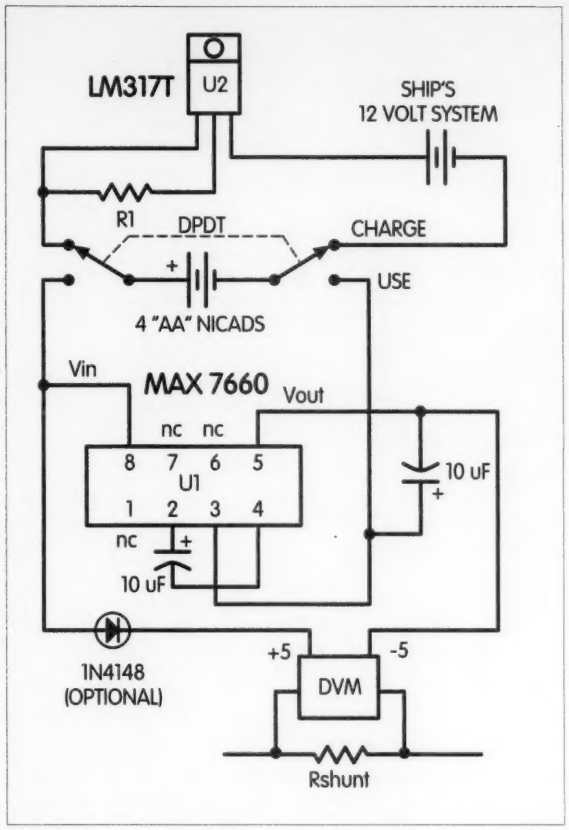

Fig. 4. Powering the 9 V DVM with four NiCds. I_{chg} = 1.25/R1 amps. For I = 40 mA, R1 = ~30 ohms, 1/4 watt.

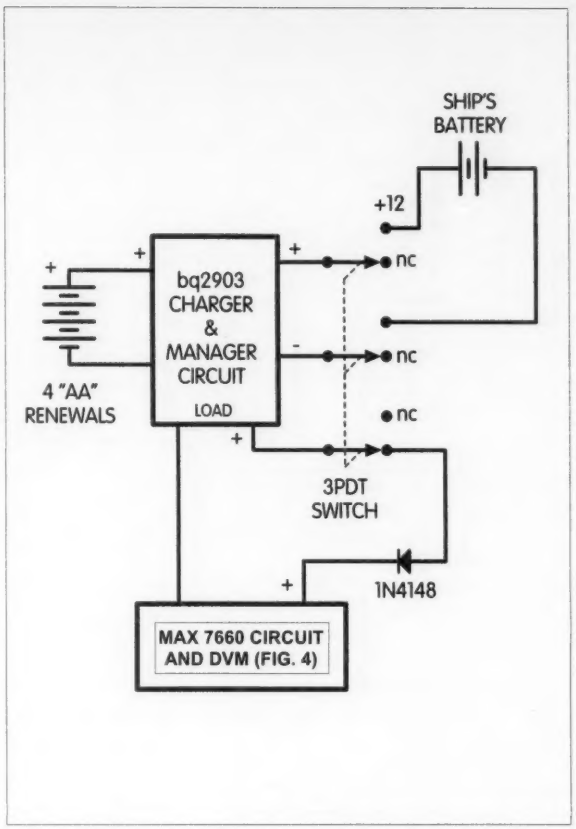

Fig. 5. Powering the DVM with rechargeable alkaline batteries, using a 3PDT switch.

an output voltage that is the negative of the input voltage: five volts positive in (from the four NiCds), minus five volts out. Put a diode in to protect the meter and you have nine volts between the positive and negative voltages. Actually, you do not need a diode at all, as the meter is designed to operate at up to 12 volts (absolute maximum).

Because I planned to mount the meter permanently in the boat, I needed to be able to recharge the batteries in place. This I could do with the ship's power. A simple current source and a DPDT switch did the job. When the meter is off, it is being charged. When it is on, it works from a floating source. Notice that I use a double-pole switch because when the meter is being used, the ground circuit for it must be separate from the ship's ground. The meter worked well all summer, it was accurate and, although I had feared that alternator noise might give strange readings, I found this was not the case.

Despite the fact that it worked well, I had a number of concerns with this arrangement. First, if I forgot and left the meter *on* for a long period of time, I could drain the NiCds and get cell reversal. Second, if I left the meter *off* for a long period of time, I could overcharge the NiCds. I could prevent overcharging by setting the charge current very low, but then it would take a long time to recharge the batteries if I let them run down. Finally, since I would generally only have the meter turned on for short periods of time and then put it back in the charge mode, I would be charging the batteries in a short cycle mode which promotes "memory" effect and eventual capacity loss. These concerns bothered me all summer. I thought about it and suddenly realized I had recently done a project that was custom made for use with this meter.

Four rechargeable alkaline batteries: In my project "Are You Ready to Recharge?" (*73*, March 1997, p. 40), I discussed the characteristics of rechargeable alkaline batteries and presented a circuit that both charged them and monitored their use to prevent excessive discharge. You may recall that the advantages of rechargeable alkalines are:

They are less expensive than NiCds.

They have a much longer shelf life.

They prefer to be recharged often and do not have "memory."

They work best with low current draws.

The disadvantage of rechargeable alkalines is that they will lose a lot of their potential capacity if they are allowed to run down too far. My project made use of a bq2903 chip that monitored battery status to prevent this problem. In addition, it controlled the charging of these batteries to permit a maximum charge rate and yet still prevent overcharge. (Rechargeable alkalines cannot be charged in a constant cur-

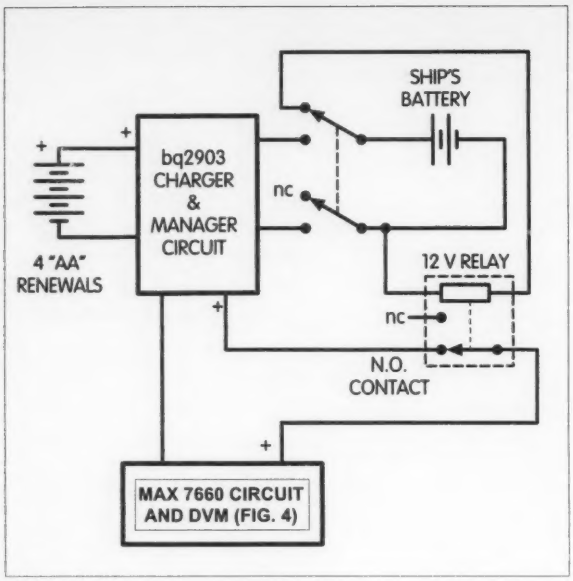

Fig. 6. Using a relay and DPDT switch.

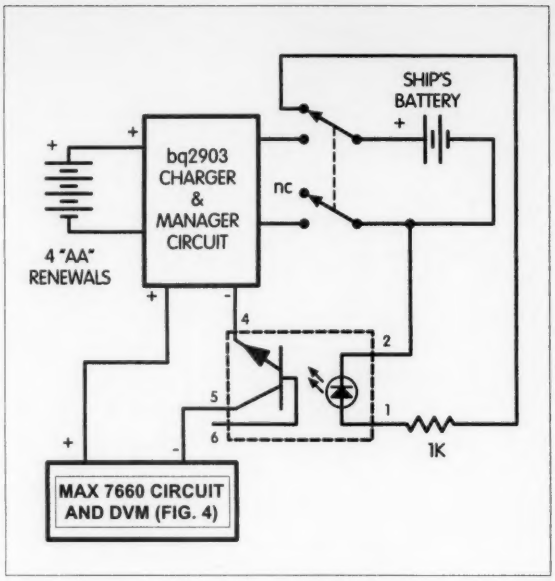

Fig. 7. Using an optoisolator and DPDT switch.

rent fashion as NiCds are. To do so can cause rapid deterioration of their capacity.)

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It was apparent to me that here was a perfect application for this project: The meter circuit uses only a few milliamps and I do recharge often. The bq2903 prevents overdischarge if I leave the meter on too long; there is no chance of overcharging, as the bq2903 ends the charging cycle when the batteries are charged. If I leave the meter unused for months, the batteries will still be ready to go. If I let the batteries discharge deeply, the bq2903 circuit will recharge them in only a few hours.

The circuit for this is a little more complicated than the NiCd circuit, but I had a PC board and parts from that earlier project, which made it easy to build, and the advantages made it worth the extra space. **Fig. 5** shows my circuit. When using rechargeable alkaline batteries, it is a good idea to include a diode since these batteries have a higher voltage than NiCds and four of them could cause the voltage to exceed the maximum allowable for the meter.

Because the bq2903 circuit was part of the monitoring circuit and needed to be in line all the time, it was not possible to use a simple DPDT switch as for NiCds. Three wires had to be disconnected and connected to change from "use" mode to "charge" mode. I tried three ways to do this and each worked well.

One way used a three-pole double-throw switch as shown in **Fig. 5**. This is the easiest way if you have such a switch around. If you do not, a DPDT switch and relay will work as shown in **Fig. 6**. Either a normally open (NO) or normally closed (NC) relay contact will do, depending upon how you want the circuit to work. With NC, the meter will run with no external 12 V source (charging circuit). This would work well for a circuit you want to make portable and plug into the 12 V charging source. For the boat, where my meter would be permanently mounted, I felt that a NO relay would offer the advantage that if I disconnected the ship's batteries (which I do when I store the boat), the meter would be turned off and would not run down the alkaline battery.

A third alternative would be an optoisolator (**Fig. 7**). Note that it is used in the negative lead rather than the positive. Note that it too is an NO switch, so without the ship's battery, the circuit is off. With optoisolators at about 50 cents, this seemed an inexpensive and elegant way to go.

With the number of hams who do mobile work these days, I hope the information about these circuits I built will be useful to others. The inexpensive panel meters are a real deal as long as you have a floating power source. 73

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the August issue, we should receive it by May 31. Provide a clear, concise summary of the essential details about your Special Event.

MAY 2

CADILLAC, MI The Wexaukee ARC will hold their annual hamfest 8 a.m.–1 p.m. at the Cadillac Middle School in Cadillac MI. VE exams for all classes at 1 p.m. Admission $5; 8 ft. table $6. Setup at 6 a.m., table holders only. Talk-in on 146.98 rptr. Contact *Dan KE8KU, Wexaukee ARC, P.O. Box 163, Cadillac MI 49601. Tel. (616) 775-0998; E-mail [ke8kudan@juno.com].*

COLORADO SPRINGS, CO The Pikes Peak Radio Amateur Assn. Swapfest (amateur radio and computer) will be held at Doherty High School, 4515 Barnes Rd., 8 a.m.–2 p.m., with setup at 6 a.m., and VE exams at 10 a.m. Adm. $4, under 18 free. Tables, $12 for the first, $10 each for additional tables. Talk-in on 146.970 (100 Hz CTCSS) or 146.520. Contact *Phil Pearsall KC5LXC, (719) 531-5319; or E-mail [pearsall@msn.com].*

MAY 2–3

ABILENE, TX The Key City ARC will sponsor a hamfest at the Abilene Civic Center from 8 a.m.–5 p.m. Sat., and 9 a.m.–2 p.m. Sun. Free parking. VE exams. Wheelchair access. Tables $6 each. Pre-registration $7 (must be received by Apr. 28th), $8 at the door. Talk-in on 146.160/.760. For reservations and info, contact *Peg Richard KA4UPA, 1442 Lakeside Dr., Abilene TX 79602. Tel. (915) 672-8889.*

MAY 3

YONKERS, NY The Metro 70 cm Network will hold another Giant Electronic Flea Market at Lincoln High School, Kneeland Ave., Yonkers NY, 9 a.m.–3 p.m., rain or shine. Free parking. No tailgating. Indoor flea market only. VE exams. Vendors: $19 first table, $15 each add'l table. All tables 30" x 5', or bring your own tables at $14 for a 6 ft. space. At the door $25 each table, $20 for a 6 ft. space. Full payment is due with registration. Mail reservation payments to *Metro 70 cm Network, 53 Hayward St., Yonkers NY 10704.* Spaces will not be held past 9 a.m. No refunds unless prior notice of cancellation has been received 72 hrs in advance. Donation $6, kids under 12 free. Table setups at 7 a.m. Free coffee, door prizes, grand prize drawing at 1:00 p.m. For registration, or vendors' or buyers' information, call *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 449.425 MHz PL 156.7; 223.760 MHz PL 67.0; 146.910 MHz; and 443.350 MHz PL 156.7.

MAY 9

GOSHEN, NY The Orange County ARC will present their Spring Hamfest, 8 a.m–2 p.m. at John S. Burke Catholic High School, Fletcher St. (exit 122A on Route 17) in Goshen. Admission is $5 for buyers; spouses and kids free. Tailgating $6, weather permitting. Indoor tables supplied for $10 each; $7 per space for your own table. Free parking. VE Exams. New and used rigs. SKYWARN training. ARES/RACES introduction to emergency service. For info and reservations, contact *Edward J. Moskowitz N2XJI, 123 Harold Ave., Cornwall NY 12518, (914) 534-3492.*

MANITOWOC, WI The Lakeshore Hamfest, Electronics & Computer Swapfest will open its doors at 8 a.m. at the Manitowoc County Expo Center, intersection of Hwys 42–151 and I-43 on County Hwy. Rd. Fri. night setup for vendors until 10 p.m.; also starting at 6 a.m. Sat. morning. Accommodations for vendor drive-ins. Advance tickets $3, $4 at the door. Reserved 8 ft. tables $6 each. Electric outlets $5 each. VE exams for all classes at Silver Lake College (Hwy. 151); test registration closes at 9 a.m. DXCC field checking at the expo. For info call *Glenn, (920) 684-7096, any time,* or *Red, (920) 684-9097, days.* Talk-in on 146.61(-) or 147.03(+). Send reservation payments with an SASE to *Mancorad Radio Club, P.O. Box 204, Manitowoc WI 54221-0204.*

MAY 14–17

DAYTON, OH The QRP Amateur Radio Club International will present their "Four Days in May" 1998 Conference at the 1998 Dayton hamvention®. Amateur radio QRP presentations, workshops, and demonstrations will be the focus of the all-day Thursday QRP Symposium to be held at QRP ARCI headquarters, the Days Inn Dayton South. Registration is $10 if prepaid by May 1st and $12 after that or at the door. "At the door" registration may be limited by sellout. Registration will cover a full day of QRP Symposium activities, coffee, Symposium bag stuffers and a complimentary copy of the FDIM 98 QRP Symposium Proceedings. Make payment to QRP ARCI, and send with an SASE by May 1st to *Cam Bailey KT3A, FDIM Symposium Registration, P.O. Box 173, Mt. Wolf PA 17347.* E-mail queries to *[kt3a@juno.com].* The QRP-ARCI Awards Banquet, Fri. May 15th, is being hosted by FDIM Banquet Chairperson Scott Rosenfeld NF3I. Please send an SASE and your $22 banquet ticket fee (US check, money order, international money order) made payable to QRP ARCI (by May 1st) to *Scott Rosenfeld NF3I, QRP ARCI Banquet Tickets, 4015 Sparrow House Lane, Burtonsville MD 20866-1333.* E-mail queries for more info to *[ham@w3eax.umd.edu].* The FDIM QRP Vendor Social will be held Fri. evening May 15th, with Jim Stafford W4QO, QRP ARCI VP, as the host. For registration info please contact *Jim at 11395 West Rd., Roswell GA 30075, or E-mail [w4qo@amsat.org].* The Days Inn Dayton South will be the 1998 FDIM QRP headquarters and a special block of rooms has been secured. Please contact *Hank Kohl K8DD, 1640 Henry St., Port Huron MI 48060; E-mail [k8dd@tir.com]* regarding availability of rooms. QRP Symposium presenters, please submit your QRP technical manuscripts to *FDIM 98 Technical Paper Chairperson Ken Evans W4DU, 848 Valbrook Court, Lilburn GA 30047; or E-mail [w4du@bellsouth.net].*

MAY 15

DAYTON, OH The Southwest Ohio Chapter of the Quarter Century Wireless Assn. will hold its 1998 Annual Banquet in conjunction with the Dayton Hamvention, at Alex's Continental Restaurant (off State Route 725, 1/2 mi. west of I-75). COD bar at 7 p.m., banquet at 7:30 p.m. After-dinner speaker will be Tom Cecil, Attorney (Ret) and author of *I Want My Turn In The Shower.* Reservation deadline is May 13th. QCWA membership is not a requirement for attendance. Reservations are $15 each. Make check payable to *Robert L. Dingle, Treas. Chapter 9* and mail to: *1117 Big Hill Rd., Kettering OH 45420–1201.*

MAY 16

WILLMAR, MN The Willmar Hamfest Committee will hold their 1st Annual Hamfest and Electronics Swapmeet at the Senior High School Cafeteria, 9 a.m.–2 p.m. Advance tickets $4 each, $5 at the door. Flea market space $5 per space/table; commercial vendors $10 (1'–8' table or 1 parking space). Make checks payable to Willmar E.A.R. and mail with SASE to Hamfest '98, 209 Hawaii St. NE, Willmar MN 56201. Reservation deadline is May 15th. VE exams begin at 8 a.m. sharp; doors open at 7:30 a.m. Pre-registration required; payment at the door. Walk-ins accepted only if space is available. Mail your name, call, city, state, ZIP, and which exams you wish to take to *Willmar Hamfest Committee, 209 Hawaii St. NE, Willmar MN 56201.* Talk-in on 146.91(-).

MAY 17

CAMBRIDGE, MA The MIT Electronics Research Society, the MIT Radio Society and the Harvard Wireless Club will co-host a tailgate electronics, computer

and amateur radio Flea Market, 9 a.m.–2 p.m. at Albany and Main St. in Cambridge. Admission $4. Free off-street parking for 1000 buyers. Fully handicapped accessible. Tailgate room for 600 sellers. Sellers $10 per space at the gate, $9 in advance; includes one admission. Setup at 7 a.m. For space reservations or info, call (617) 253-3776. Mail advance reservations before May 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 PL 2A W1XM rptr. Rain or shine.

MAY 22–23

PASCAGOULA, MS The Jackson County ARC will hold its 4th annual Hamfest in the Pascagoula MS Civic Center, located on the Jackson County Fairground. This is an ARRL-sanctioned event. Talk-in will be on the W5WA rptr., 145.110(-), alternate 146.880(-). Hours are 1700–2100 May 22nd, and 0800-1500 May 23rd. Admission is $2.50 for 12 and over; under 12 admitted free. Bring a copy of your license to be eligible to win a transmitter. Table rental is $8 per 8' table. RV parking available on site. Nearby hotels and motels at reasonable rates. VE exams will be available Saturday at 1200 hours. Bring your original license or CSCE plus a copy, a picture ID, and $6.35. The Novice test is free. Contact *Charles F. "Kim" Kimmerly N5XGI, Hamfest Chairman, 19000 Busby Rd., Vancleave MS 39565. Tel. (228) 826-5811.*

MAY 23

DURHAM, NC The 24th annual Dur-Ham-Fest will be held at South Square Mall, 8 a.m.–3 p.m. Tickets $4 in advance, $5 at the gate. Send SASE and payment before May 10th. Tables $10 in advance, $12 at the gate as long as they last. Tailgaters $5 per space plus admission. Info, tickets and reservations contact is *Rodney Draughon AE4JW, 794 Harris Mill Rd., Rougemont NC 27572. Tel. (336) 364-7420; E-mail [ae4jw@juno.com].* VE exams 10 a.m.–1 p.m., pre-registration requested. Walk-ins welcome. Contact *David Snyder N2MLU, 4505 Governor Hunt St., Efland NC 27243; (919) 644-8681.*

MAY 24

CHICAGO, IL Chicago ARC will hold their annual Hamfest at DeVry Institute of Technology, 3300 N. Campbell, 8 a.m.–3 p.m.; setup at 6 a.m. Tickets $4 in advance, $5 at the gate. Indoor tables $1.50/ft. Outdoor swapfest space and parking free. Talk-in at 147.255(+). For info and reservations write to CARC, P.O. Box 410535, Chicago IL 60641-0535; or write to *CARC, 5631 W. Irving Pk. Rd., Chicago IL 60634;* or call *George (773) 545-3622; or Dean (708) 331-7764.*

MAY 30

LOVELAND, CO The Northern Colorado ARC will sponsor a Superfest Swapmeet 8 a.m.–3 p.m. at Larimer County Fairgrounds, 700 S. Railroad. Free parking, commercial exhibitors, VE exams. Admission $3, tables $8 each; contact *Jeanene Gage NØYHY, (970) 351-7327.* For general info, contact *Michael Robinson N7MR, (970) 282-1167.* Talk-in on 145.115(- 100) and 146.52.

MAY 31

FAIR OAKS, CA The North Hills Radio Club (of Sacramento) will hold its annual Swapmeet 6 a.m.–12 p.m. Sunday, May 31st, at the Bella Vista High School, 8301 Madison Ave. in Fair Oaks. From I-80, take Madison Ave. east for 5.8 mi. to H.S. From Hwy 50 take Hazel Ave. north 1.5 mi. to Madison Ave., turn left and go west 1 mi. to H.S. Seller spaces $10 (two parking spaces), buyers enter free. New, used and surplus amateur radio gear, electronic test equip., and amateur-related computer gear. Contact *Bob Maylor AC6HF, (916) 966-3654; E-mail [ac6hf@juno.com].*

JUNE 6

TEANECK, NJ The Bergen ARA will hold its annual Fall Hamfest at Fairleigh Dickinson Univ. Buyer admission $5 with XYLs and harmonics free. Seller admission $10. VE exams. Take Route 4 east/west to the River Rd. exit. Follow the signs into the hamfest area. Talk-in on 146.790(-600). Contact *Jim Joyce K2ZO at (201) 664-6725 before 10 p.m.*

JUNE 7

BETHEL PARK, PA The 44th Breezeshooters' Hamfest will be held Sunday, June 7th, 8 a.m.–4 p.m. on the Butler Farm Showgrounds, just north of Butler. Handicapped accessible. Admission $5 per person, under 12 admitted free. Take PA Rt. 68 East from Interstate 79, or take US Rt. 68 West from PA Rt. 8. Talk-in on 147.96/.36. Vending tables $15 per table, rented in advance, first come, first served. Reservation deadline is May 15th. Send payment with an SASE to *George Artnak N3FXW, 3350 Appel Rd., Bethel Park PA 15102,* or call the *Breezeshooters' Hotline at (412) 854-5593;* or via E-mail to *[geoart@usa.net].* Check out the Breezeshooters' Web site at *[http://www.users.sgi.net/~wolfie/].*

JUNCTION CITY, WI The Central Wisconsin Radio Amateurs, Ltd. (CWRA), cordially invites your participation at their 21st annual Swapfest and Auction, Sunday, June 7th, at the US Army Reserve Center. This is a new location and offers Saturday evening setup and overnight security, as well as inside-the-building loading and unloading. Tables are $4 each if requested prior to May 15th. After May 15th, tables will be $7 plus admission. Admission tickets will be $3, and free for children under 12. Doors open to the public at 8 a.m. (6:30 a.m. to vendors choosing Sunday morning setup), with shutdown by 1:30 p.m. We are encouraging tailgaters to sell their unsold goods at our auction at noon. Talk-in on 146.670 WB9QFW and 146.985 W9NN repeaters. Contact *John Feltz W9JN, CWRA Swapfest Chairman, 973 East First St., Junction City WI 54443-9614. Tel. (715) 457-2506; E-mail [jfw9jn@tznet.com].*

MEDINA, OH Join the M2M Group for the 1998 Medina County Hamfest, Sunday, June 7th, at the Medina County Fairgrounds Community Center, 735 Lafayette Rd., Medina OH. Vendor setup at 6:30 a.m. Open to the public 8 a.m.–3 p.m. Reservation deadline is May 23rd. Enclose an SASE for return of tickets. Send advance payments to *Medina Hamfest Committee, P.O. Box 452, Medina OH 44258.* Please call *(330) 725-0119* for info about VE exams; walk-ins welcome. Mobile check-in on 147.630/.030.

PRINCETON, IL The Starved Rock Radio Club Hamfest will be held at the Bureau County Fairgrounds in Princeton IL. Doors open at 6 a.m. Advance tickets are $5 with 4 stubs before May 20th, and $6 with a single stub at the gate. Camping and outdoor flea market area is free. 8' tables indoors are $10 each. Talk-in is on 146.355/.955 PL 103.5. Contact *Bruce Burton KU9A or Debbie Burton N9DRU, 1153 Union St., Marseilles IL 61341-1710. Phone (815) 795-2201; E-mail [brburton@mtco.com].*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the NY Hall of Science parking lot, Flushing Meadow Corona Park, 47-01 111th St., Queens NY. Doors open for vendor setup at 7:30 a.m. Buyers admitted at 9 a.m. Free parking. Buyer's donation $5 , seller's $10 per space. Talk-in on 444.200 rptr., PL 136.5. Contact at night only, *Stephen Greenbaum WB2KDG, (718) 898-5599;* or *E-mail [WB2KDG@bigfoot.com].*

JUNE 13

FERGUS, ONTARIO, CANADA The 24th Central Ontario Amateur Radio Fleamarket will be held at the Fergus and District Community Center (just a few miles north of Guelph on Hwy. 6), beginning at 8 a.m. Setup at 6 a.m. Snack bar and rest rooms open at 6:30 a.m. General admission $5, under 12 free. Tailgating $5 per space; indoor tables $10 per 8' space. On-site fully serviced campground lots available at $13.75 per night. Talk-in on VE3ZMG at 145.21; VR3KSR at 146.97; or simplex 146.52. Make all checks payable to *Central Ontario Amateur Radio Fleamarket* and mail with SASE to *Bill Smith VE3WHS, 32 McElderry Rd., Guelph Ontario N1G 4K6, Canada. Tel. (519) 821-6642. E-mail [fleamarket@kwarc.org];* or check the Web site at *[www.kwarc.org/fleamarket].*

PADUCAH, KY The Paducah ARA Hamfest will be held Saturday, June 13th at the Executive Inn Convention Center in downtown Paducah, 8 a.m.–3

p.m. VE exams at 1 p.m. Plenty of free parking. Admission $5, tables $6 each, with one free ticket per vendor. Write to *The Paducah Amateur Radio Assn., P.O. Box 1022, Paducah KY 42002-1022; or E-mail [KC4ENA@Apex.Net].*

JUNE 14

ERLANGER, KY The Northern Kentucky ARC, Inc. (of Covington KY), will host their "Ham-O-Rama '98" June 14th, 8 a.m–3 p.m. at the Erlanger Lions' Park. Take I-75 to Exit 184 (Route 236 East). Go one mile and turn right on Dixie Hwy (US Route 25 & 42). Go one mi. to Sunset Avenue, turn right and go to the end of Sunset Ave. For more info or advance registration, contact *Robert Blocher N8JMV c/o NKARC, P.O. Box 1062, Covington KY 41012. Call evenings at (513) 797-7252.* Or call *Neal KC4FET, (606) 341-1213; or Ken KZ5KR, (606) 384-4002.* Indoor exhibit area for major vendors. Extensive outside flea market with setup at 6 a.m. Tickets $4 in advance, $5 at the gate; children under 13 admitted free. Flea market spaces $2 each (bring your own table and chair). Indoor vendor space $15 per table (provided). Registration deadline is June 1st. Send remittance with an SASE. Talk-in on 147.255(+) or 147.375(+) K4CO rptr.

JUNE 21

CROWN POINT, IN The annual "Dad's Day" Hamfest, sponsored by the Lake County ARC (of Merrillville IN) will be on June 21st at the Lake County Fairgrounds in Crown Point. Talk-in on 147.00, 146.52 and 442.075. There will be computers, software, and hardware vendors. Setup begins at 6 a.m. Doors open to the public at 8 a.m. Admission $5 per person, tables $6 each. Contact *Malcolm Lunsford W9MAL, 6721 Harrison Ct., Merrillville IN 46410-3323. Tel. (219) 769-3925; or E-mail [w9mal@cris.com].*

JUL 26

HONOLULU, HI In celebration of their third wedding anniversary, a grand Ham-Boree is being planned by Gordon Crowhurst G4ZPY and Brenda in the form of a big get-together of hams and their partners for an evening meal in Honolulu. They would like to put a face to a callsign, a face to a name, of their many friends and acquaintances all over the world. For those who are interested, there are a lot of nearby mountains for DXing on the Pacific Rim. For more info contact *G4ZPY Paddle Keys International, 41 Mill Dam Lane, Burscough, Ormskirk, L40 7TG England. Tel./FAX (44) (0)1704-894299* anytime until 2300, but not between the hours of 1600–1830 local time. Everyone must make their own holiday arrangements themselves and pay for their evening meal. Please R.S.V.P. so that a suitable location may be arranged for the get-together.

AUG 8

HUNTINGTON, WV The Tri-State Amateur Radio Assn. (TARA) will hold their hamfest at the Huntington Memorial Fieldhouse at 2590 5th Ave. For more information call *Bernie Mays at (304) 743-5459, or E-mail to [wb8zer@juno.com].*

SPECIAL EVENT STATIONS

MAY 1–2

BEAVERCREEK, OH Members of the Upper Valley ARC will be assisting nine-, 10- and 11-year-old elementary school children as they hold their special event station commemorating the 4th Anniversary of Parkwood Elementary School's fourth grade class "Adopt-A-Ham Program." Mike Fisher KI8CJ is founder and instructor of the students involved in this program. Each volunteer ham is assigned four or five of Mike's students in the beginning of the school year. On a weekly basis the amateur and children hold a scheduled QSO on UVARC's two-meter repeater. By the end of the school year the children have developed valuable communication skills and the participating amateurs learn a thing or two from the youngsters. The special event station will operate for 24 hours, beginning at 2000 UTC on May 1st, using the call KI8CJ. Frequencies: 145.11, Kettering Medical Center; 146.64, Miami Valley FM Assn.; 146.94 Dayton ARC; 147.135, Far Out ARC, and 145.41, Upper Valley ARC. Special QSL cards will be issued to those confirming contact in writing to *Mike Fisher KI8CJ, Parkwood Elementary Schools, 1791 Wilene Dr., Dayton OH 45432.* An SASE must be included to receive a QSL card. Please submit your QSL request immediately after the event, since school will be out the first of June. Any requests received after June 1st will be held until school begins in the fall.

MAY 1–3

MARTHA'S VINEYARD ISLAND, MA The Fall River ARC, on a mini-DXpedition, will operate W1ACT/P from the historic Gay Head Cliffs and Lighthouse on Martha's Vineyard. Operation may be on or near IOTA net frequencies and with all Extra class privileges, propagation permitting. Please QSL via *Roland Daignault, Jr. N1JOY, 19 Davis Rd., Westport MA 02790. E-mail [roland-d@ici.net].*

MAY 2–3

1998 CONNECTICUT QSO PARTY The Connecticut QSO Party, sponsored by the Candlewood ARA, will operate 2000Z May 2nd–2000Z May 3rd, with a rest period 0400–1200Z. Phone, RTTY and CW. CW—40 kHz up from lower band edges; Novices 25 kHz up from low end; phone—1.860, 3.915, 7.280, 14.280, 21.380 and 28.380. VHF—50.150, 144.200, and 146.580. RTTY—normal RTTY bands. All bands (HF, VHF, UHF) except WARC bands count. For rules and info, please contact *CARA, P.O. Box 3441, Danbury CT 06813-3441 USA.* Remember to enclose an SASE. Send entry and SASE for results by June 3rd.

Continued on page 86

Number 40 on your Feedback card

Brits Get Gaussian

... with GMSK Data Products' high-speed packet modem.

Roger J. Cooke G3LDI
The Old Nursery, The Drift,
Swardeston, Norwich,
Norfolk NR14 8LQ, UK
[mtaylor@uk.mdis.com]

GMSK Data Products is a partnership company set up by two professional electronic design engineers who are also keen radio amateurs: Matt G6WPJ and John G8STW. They are the sysops of the TCP/IP packet stations GB7WPJ and GB7STW, respectively. Matt and John are also avid members of their local TCP/IP group, the Essex IP Group or EIPG.

Their first project was to design a high-speed modem for use by radio amateurs. They wanted to see if better than 9600 bps was possible in normal 25 kHz channels, as well as to modernize on the excellent design created some years ago by James Miller G3RUH. The result was the Vfast28.8 modem adapter for a TNC2.

This proved very effective, and as a result of an approach from the Essex group and the East Anglian Data Group (EADG), Matt and John decided to develop a real-time bit repeater for speeds of up to 38,400 bps. In fact, they managed 57,600 bps and two further products resulted: the AX384 and the AX576.

These new TNC designs have generated a lot of interest and are now being looked at by a number of packet groups around the UK as the basis for the new high-speed network. The Vfast28.8 modem adapter also developed into a full RS232-driven radio modem for transparent data transfer not using the overhead of AX25: the RSM192. And a smaller, more compact version—the RSM192S—has also been produced as a custom project for a company in the USA.

These well-engineered products use modern design techniques, including the PIC family of microcontrollers for high-speed bit processing. In the RSM192, the PIC micro is used to manage the RS232 comms, handle a complex two-speed fast-frame acquisition sequence, generate a very effective data carrier detector, and provide real-time bit randomizing. The PCBs are of very high quality and the layout is done with good analog-to-digital separation in mind. Quality in design and production is taken very seriously by both Matt and John.

GMSK

A method of data modulation known as Gaussian Minimum Shift Keying (GMSK) is used to pass data as fast as practicable in the radio channel. GMSK modulation and demodulation and the modems' control and data coding can all be performed by the latest integrated circuit devices. This makes for a compact design and layout which is easy to build and provides for high performance.

Features

- Radio port speeds of 4800, 9600, 19200, and 38400 bps with AX384; 7200, 14400, 28800, and 57600 bps with AX576.
- The high-speed radio modem operates full duplex at all the radio speeds above with no component changes.
- RS232 port speeds from 9600 to 38400 bps (AX384) or 115200 bps (AX576).
- TAPR TNC-2 EPROM-compatible, including NET/ROM and 64 K EPROMs such as TheNet X1J and ROSE.
- A real-time bit repeater can be enabled from software; it provides a contention-free LAN in its coverage area. An intelligent FIFO buffer allows transmission of long frames without bit under-/overruns. Other TNC functions are unaffected, allowing simultaneous use, e.g., as a Node—TheNet X1J.
- Setup software in ROM allows modem configuration to be modified on screen.
- Live link-bit error rate measurements enable easy setup of data links.
- Full Morse ID as per UK license regulations, regardless of TNC software fitted. This can be disabled for use elsewhere.

• 96 K ROM space allows (in addition to Setup and KISS ROM) 1 x 32 K EPROM, 1 x 64 K EPROM or 2 x 32 K EPROM images to be fitted.

• 128 K RAM can be fitted in place of the normal 32 K if required.

• Radio control signals PTT and Mute can be set active high or low from setup software.

• 10 MHz Z80 processor ensures no lost or missed frames due to software errors.

• Choice of data randomizer allows G3RUH or GRAPES method to be used.

• Bi-phase data coding can be selected in place of data randomizer to allow simple interfacing to most types of voice radios (includes FM/PM crystalled or synthesized).

• RS485 interface option allows multiple TNCs to be connected in "Node Stack" with simple four-wire cable. No more diode matrices!

Frequency shift keying

The simplest method of sending data signals over an FM radio is to use a frequency shift in one direction to represent a logic 1 and a frequency shift in the other direction to represent a logic 0. For example, a transmitter may operate on a carrier frequency of 144.500 MHz and move its carrier down by 3 kHz to 144.497 to signal a logic 0, and then up 3 kHz to 144.503 MHz to represent a logic 1. Note that no audio subcarrier is used. This is shown in **Fig. 1**.

This method, known as FSK, in fact works well and is used widely at present on the UK network with the usual two meter and 70 cm rigs. However, it has been shown that an efficient form of FSK occurs when the frequency shift (dF) is half the data rate (DR) of transmission. This form of FSK is known as Minimum Shift Keying (MSK). Expressed in mathematical terms, the definition of MSK becomes:

$$dF = DR/2$$

In the example in **Fig. 1**, the total frequency shift is 6 kHz. It can therefore be inferred that if MSK is being used with this deviation, the data rate must be 1200 bps. A further requirement of MSK is that the change from one signaling frequency to the other must be done with a continuous waveform and with no phase discontinuities. Although this may not be true with the Vfast28.8 modem, there is no practical effect on its actual performance.

It is apparent that although the Vfast28.8 modem is described as a (G)MSK modem, this will only be true if the radio peak deviation is set up to be half the data signaling rate, e.g., 7200 Hz for a 14,400 bps transmission speed.

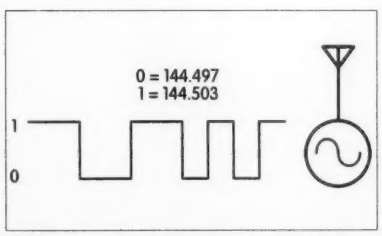

***Fig. 1.** Using frequency shift keying, an FM radio can transmit in one direction to represent a logic 1 and in the other to represent a logic 0.*

Gaussian filters

The main reduction in bandwidth comes from the use of frequency shaping before FM modulation takes place. This is done by taking the square waves of the serial data signal and passing them through a low-pass filter. One type of suitable filter is the Raised Cosine Filter which is used in some radio modem designs.

The Vfast28.8 modem uses a so-called Gaussian filter. A Gaussian low-pass filter is a filter which, when excited by a single impulse at its input, gives a Gaussian-shaped output response. The shape known as a Gaussian curve is also sometimes known as a Normal Distribution curve.

The Gaussian filter provides an excellent shape for radio data applications. If the basic FSK transmitter is modified by the use of MSK and the addition of a Gaussian input filter to give a GMSK system, the resultant bandwidth of the data signal is now much reduced and is suitable for transmission by a narrowband FM radio. This is illustrated in **Fig. 2**.

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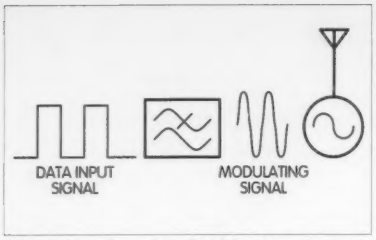

Fig. 2. *Resultant bandwidth reduction with the use of a Gaussian filter.*

The frequency at which the low-pass Gaussian filter starts to work has a direct influence on the bandwidth used for transmission. The lower the frequency relative to the data rate of the signal, the narrower the transmission spectrum, but the higher the likelihood of bit errors during transmission. The ratio of the -3 dB point of the low-pass filter (F1) to the data rate is known as the BT value. This can be shown by:

BT = F1/DR

The Vfast28.8 design provides the ability to select two BT values (0.5 and 0.3) for each data rate. As a guide, the following figures can be regarded as the maximum data rates which can be achieved in different channel bandwidths using BT values of 0.5 and 0.3. For BT = 0.5, 4800 bps in 12.5 kHz; 9600 in 25.0; 19,200 in 50.0. For BT = 0.3, 8000 bps in 12.5 kHz; 16,000 in 25.0; 32,000 in 50.0.

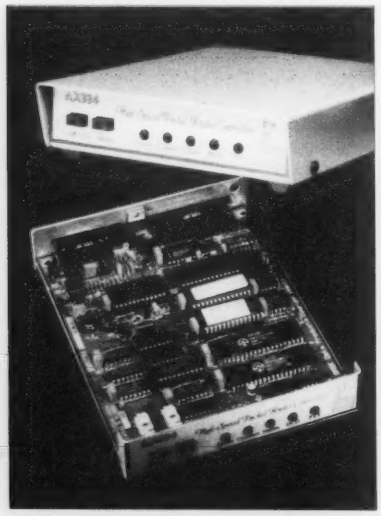

Photo A. *The AX384 is a handsome unit inside and out.*

GMSK as a method of transmission is simple and effective. It does, however, require care with some points. These mainly concern the transmission of long strings of "1"s and "0"s. This is because a string of 1000 logic "1"s will appear as a single frequency shift at the beginning of the string and a further frequency shift at the end of the string.

This can lead to problems with the receiver not being able to track the incoming signal correctly. Both bit timing and lever information can be lost. When a BT value of 0.3 is being used, problems also occur with single bits bounded by their complement being sent repeatedly. For example, the bytes 00010000 or 11111110 sent many times over can cause the GMSK demodulator to give out bit errors.

All problems of this type can be avoided by the use of a data scrambler or randomizer in the modem design. The Vfast28.8 modem includes this function in the modem controller device. Because the data will still contain some low frequency content, the radios must be able to carry, without distortion, frequencies as low as 30 Hz in transmit and 40 Hz in receive. The upper frequency limit required is dependent on the data rate used.

Considerations

The Vfast28.8 full-duplex radio modem provides excellent performance in the most demanding conditions. When used at 9600 bps it is compatible with other modem designs. However, it is capable of much more. Both versions, the AX384 and the AX576, include the K9NG data-randomizer as a default option. The GRAPES randomizer is also included. However, the user can also select the alternative method of data coding, known as "bi-phase coding," as described above. This makes interfacing to typical voice radios much easier.

A unique feature in both modems is the inclusion of a "real-time bit repeater." This allows the user to install a contention-free LAN in an area.

The operation is as follows: The repeating station is equipped with an AX384 or AX576 TNC and a full-duplex radio. This radio has split transmit and receive frequencies. The stations wishing to use the repeater use split frequency half-duplex radios. This is the same situation as with a voice repeater. As soon as one of the user stations starts to transmit data, the repeater keys its transmitter and starts to relay the input data. As soon as the other user stations detect that the repeater is sending they are inhibited from transmitting. Thus all contention to access the repeater is avoided.

Since the data is present in real-time, this is unlike a normal node, where the packet must be fully received before it is forwarded to its end destination. The bit repeater in the AX384 and AX576 includes full data bit rate clock regeneration to avoid excessive clock jitter on the repeated data. It also includes an extending FIFO buffer to ensure bits cannot overrun or underrun where the bit rate clocks of the user stations and the repeater are slightly different.

Software and setup

The main operating software ROM supplied includes a KISS mode driver for the TNC and a Setup program. For many users such as those running G8BPQ Node, KA9Q TCP/IP, and Linux AX25 software, this is all that is required. The Setup program allows the user simply to configure some TNC and modem functions. It may be driven by a simple terminal program or a Windows™-based program (supplied with the TNC).

The Setup mode is activated by holding in the "Setup" button while switching on the TNC. It also allows various test signals to be generated by the radio modem to enable the user to get the best performance from the connected radio equipment. When used on a radio link with an AX384 or AX576 at each end, the users may do bit error rate measurements on the link to allow fine-tuning of the RF equipment for best performance.

As you can see, the AX384 and AX576 are state-of-the art TNCs, yet they are available in both kit and assembled versions. Full user documentation is

Continued on page 45

WeatherWarn Goes Public

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WeatherWarn™ is a concept I developed and implemented back in 1989. Its purpose is to alert me, via ham radio, when severe weather is forecast and/or when severe weather is imminent. It is a means by which a weather-alert monitor connects to a VHF ham radio and an autodial pager through an electronic interface.

This interface activates outputs that drive devices to perform certain tasks, such as buzzers, lights, radio DTMF tones, autodial alarm systems, etc., depending on what the user needs. It responds to the weather-alert monitor siren from a contact closure, digital pulses, etc.

WeatherWarn can be used with ham radio transceivers, scanners, handhelds, repeater controllers, home alarm systems, etc. By knowing the interface requirements, you can custom-design the interface to control specific devices. The siren is activated from the National Weather Service's NOAA Weather Radio Network.

[WeatherWarn™ and WxWarn™ are US trademarks assigned to the author and copyright © 1989–1998 by him under US copyright #461-226. He is now releasing the circuit design for use or modification by the public. — ed.]

NOAA Weather-Alert System

The NOAA Weather Radio Network Alert System is a countrywide network of weather transmitters that relay current and forecast weather information from meteorologists at National Weather Service offices within the United States. When severe weather conditions warrant, the NWS activates weather-alert tones that are transmitted on NOAA radio frequencies. These frequencies are received on weather-alert receivers that can be purchased locally. These receivers generate loud sirens when in receipt of these weather-alert tones. Thus you have real-time, 24-hour-a-day weather monitoring and alerting within most areas of the US.

WeatherWarn theory of operation

WeatherWarn is triggered by a siren in the weather-alert monitor's internal speaker. The weather monitor I use is an older Radio Shack® wood-grain version. They have superseded it with a new model that functions the same way. The siren is a 1050 Hz single tone. This tone is sampled and detected by the WeatherWarn interface's front end.

After receiving this tone for a predetermined time, the interface reacts by driving multiple comparators which connect to appropriate outputs (buzzers, relays, timers, etc.). After the alert monitor siren stops, the interface active-outputs go back to their pre-active states, waiting for the process to start again. The weather monitor's speaker is muted until NOAA radio transmits the 1050 Hz tone.

General circuit interface description

The interface inputs consist of the alert monitor's speaker output and a nine-volt tap from an internal pickoff point at the monitor's battery connection. The speaker audio connects to a two-stage, high-impedance, low-pass filter. This is a second-order filter at -40 dB per decade of frequency. See **Figs. 1** and **2**. The output from the low-pass filter charges an R/C network for a predetermined time. When the voltage reaches a certain threshold, determined by the comparator's voltage divider network, the comparators toggle their output states.

These outputs then drive the appropriate devices to which they are connected. After the comparator's reference level drops, the interface returns to its

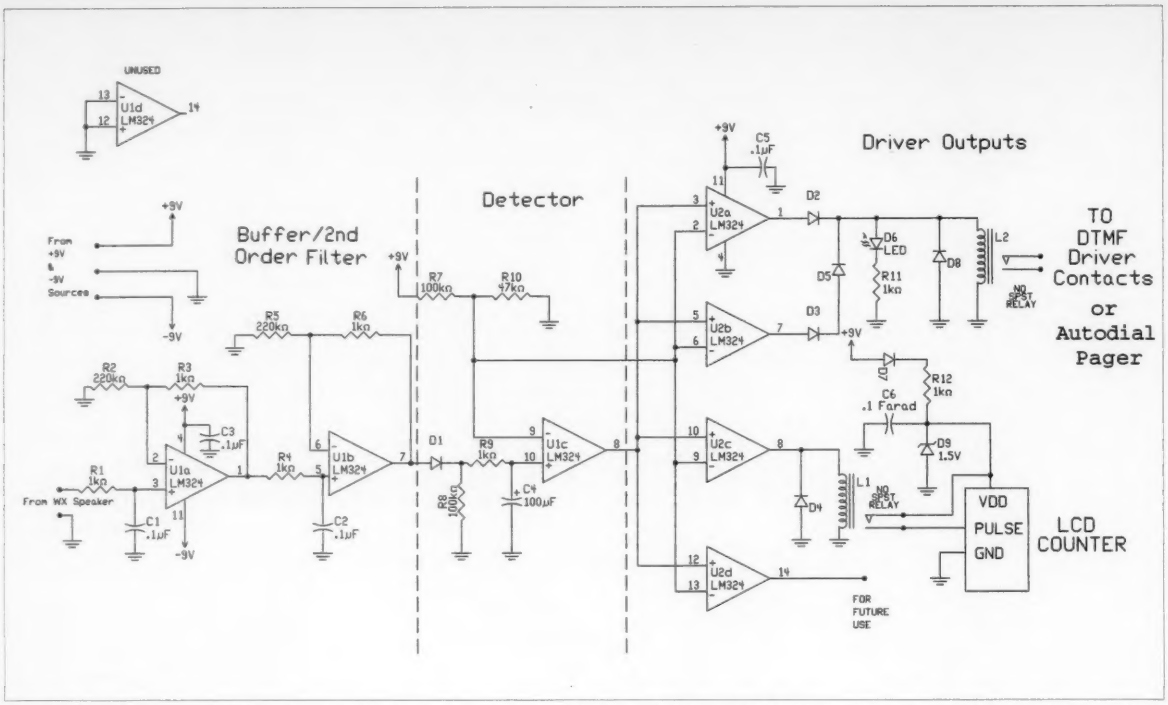

Fig. 1. WeatherWarn interface schematic. Unless otherwise specified, all diodes are 1N4007, all resistors are ±5%, and all capacitors are +16 V.

standby mode, waiting for the next siren. With the existing design, when you're listening to weather from the monitor, you should lower the volume to prevent the interface from activating. Human speech is typically from 300–3000 Hz. Modifying the input filtering by adding additional second- or third-order filters can sharpen the input response "skirts" to prevent ordinary audio from triggering the interface.

Detailed circuit interface description

Op amps U1A and U1B are cascaded to produce a second-order, low-pass filter. R1,C1 and R4,C2 set the filter's cutoff frequency using the following formula:

$F = 1/2\pi R \times C$.

At cutoff, the output voltage is -3 dB from the rail voltage of +9 V. Op amp U1C detects the siren after a preset time-constant calculated from R9 x C4. D1 prevents C4 from discharging into U1B. R8 is used to drain the capacitor charge if U1C's input pin 10 opens up. R7 and R10 form a voltage-divider network that sets the trigger voltage.

When the voltage from the siren goes above this voltage, U1C's output goes high and the output states of the drivers go active. Op amp U2 has four op amps that are used to operate or drive the appropriate outputs connected. U2A and U2B drive the main relay that operates my VHF amateur radio.

D2, D3, and D5 ensure that only one op amp drives the relay instantaneously. If one output opens, the other output will continue the operate the relay. D4 and D8 attenuate high, negative voltages that are produced when the relays go from active to inactive states. All diodes are 1N4007, high-PIV-rated. Both source (rail) supply voltages are needed for proper filter response. You can use a single +9 V source, but the filter frequency response and output voltage may change when trying to filter the 1 kHz incoming tone. R2, R3, R5, R6, R7, and R10 may have to be changed when using a single supply voltage. *Note:* The monitor's supply voltage is *not* regulated. When the siren activates, the supply voltage drops from 9 V to approximately 3 V. Please verify that the reference voltage between R7 and R10 is correct for proper triggering.

Fault tolerance

I have designed WeatherWarn to be used in a high-frequency, high-static environment. Its first remote application was with a computer-controlled repeater system, housed in a remote area. I chose to incorporate standard fault-tolerant designs/components to ensure that the outputs do not change state due to noise, static, etc. The following "hardening" was used:

- The use of commercial-grade op amps (LM324) provides for cold temperature operation.
- Tantalum capacitors provide high-frequency response.
- Grounding all unused IC inputs reduces noise pickup.
- Isolating the buffer/filter from the driver comparators, by using two separate ICs instead of one, reduces the chances of false triggering if the front-end filters are destroyed.

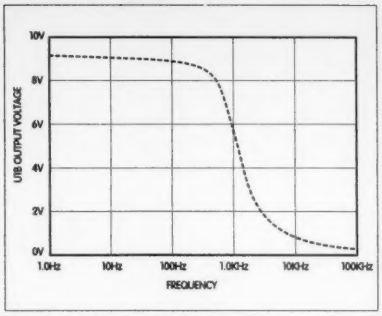

Fig. 2. WeatherWarn frequency response curve.

•Double-driving the output relay provides redundant outputs in case one output fails.

•DC input can be protected by using reverse-voltage diodes, high-frequency filter capacitors, and chokes if necessary.

•Two ground inputs from the weather monitor—one from the speaker and one from the DC source, isolate the audio ground from the power ground. This keeps the logic-level reference ground at or near zero volts for proper operation.

Output devices

My existing interface drives an LED, a relay, and an LCD counter. The relay is normally open (N.O.) and connected in parallel with a key on my DTMF microphone. When WxWarn activates, the LED turns on, the LCD counter increments by one, and my base VHF radio sends a DTMF tone on a pre-chosen frequency to the dual-band radio in my car. My HT is tuned to receive that signal, which is duplexed from my car. My interface is very cost-effective and provides me with a few desired functions. Some other ideas for output devices could be buzzers, triac-driven lights, autodial alarm systems that dial a programmed number, 555 timers, voltage-to-frequency converters, microprocessors, etc. 73, and enjoy!

Web page

Please address any questions, comments, or creative ideas to me via my personal Web page, whose URL is shown at the top of this article. My site is devoted to weather data/images, WeatherWarn, and free utility software I have designed. 73

Parts List

R1, R3, R4, R6, R9, R11, R12	1 k resistor ±5%
R2, R5	220 k resistor ±5%
R7, R8	100 k resistor ±5%
R10	47 k resistor ±5%
C1, C2, C3, C5	0.1 µF 16 V
C4	100 µF 16 V
C6	0.1 F 16 V
D1, D2, D3, D4, D5, D7, D8	1N4007
D6	LED
D9	1.5 V zener
U1, U2	LM324
L1, L2	N.O. relay, SPST
LCD counter	Builder's choice

***Table 1.** Parts list.*

Brits Get Gaussian
continued from page 42

included in electronic form along with a Windows™-based program to control the Setup mode. The construction is from high quality materials including an RFI-screen-coated stylish gray casing. The styling is designed to match well with modern office and computer equipment. The PSU is extensively filtered and smoothed to ensure correct operation of the TNC even in the presence of strong RF fields.

This TNC is being used in the local East Anglia area as the basis of our high-speed backbone, hopefully operating at 19,200 bps full duplex on 23 cm. Some problems are being experienced with the RF gear for 23 cm at present, but hopefully these will be resolved soon. For anybody looking for a high-speed TNC, at up to 57,600 bps, this would be an ideal answer.

For further information, contact GMSK Data Products, 80 Clone Road, Halstead, Essex CO9 2HP, UK. E-mail: [sales@nuthatch.dungeon.com] or [info@gmskdata.co.uk]. Web site: [http://www.gmskdata.co.uk]. 73

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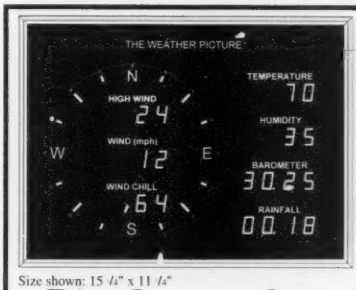

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How Safe Is Your Mobile?

Assuming you want to know ...

Robert W. Vreeland W6YBT
45 Maywood Drive
San Francisco CA 94127

During much of last year, the FCC repeatedly yielded to pressure to relax its RF safety regulations. First stations running less than 50 watts, and then push-to-talk mobiles, were exempted from evaluation. Then the deadline for evaluation was extended from January of 1997 to January of this year. Now they have ruled that amateur stations running less than the specified power level on each band are exempted from evaluation.

Unfortunately, relaxing the safety regulations may not be in the best interests of amateur radio. Don't we realize that the rules were written to protect us? Although the ham who complies with the new power limitations may never be required to evaluate his station, a prudent operator will make measurements or calculations to ensure that his station is safe. At W6YBT, we measure field strength with a calibrated hula hoop, as described in my article in the June 1997 issue of *73*. Unfortunately, both measurements and calculations have limited accuracy, so why not do both and compare the results? We have done this in the two-meter near field, and here are our findings.

Most field strength calculations start with the premise that an antenna is a point source that radiates equally well in all directions. Of course, we know that this isn't true, but we have to start somewhere. We can apply corrections later. This idealized radiator will spread the transmitted power evenly over the surface of an imaginary sphere. In other words, the amount of power falling on each square meter of the sphere's surface will be the total transmitted power, divided by the surface area of the sphere. Since the surface area of a sphere is $4\pi r^2$, the power density (S) in watts per square meter will be

$$\frac{P}{4\Pi D^2}$$

where P is the effective radiated power in watts and D is the radius of the sphere in meters. We use D for distance, since the radius of the sphere is the distance between the antenna and the sphere.

Now I want to convert power density into field strength (E) in volts per meter because that is what my field strength meter measures. Ohm says that

$$P = \frac{E^2}{R}$$

or

$$E = \sqrt{PR}$$

In this case,

$$E = \sqrt{SR}$$

where S is the power density in watts per square meter and R is 377 ohms, which is the resistance of free space. So

$$E = \sqrt{\frac{P \times 377}{4\Pi D^2}} =$$

$$\frac{\sqrt{30P}}{D} =$$

$$\frac{\sqrt{30ERP}}{D}$$

where ERP is the effective radiated power (i.e., transmitter output times antenna gain). Richard Tell has used this equation in "Broadcast Radiation:

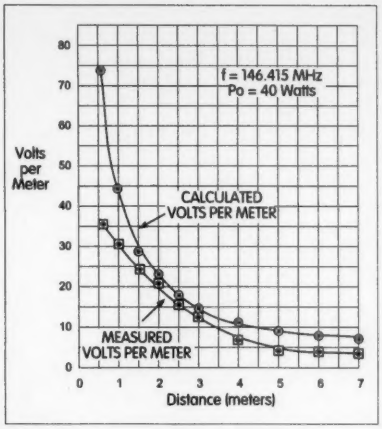

Fig. 1. Comparison of calculated and measured near field strength from a 40 W two-meter station.

How Safe is Safe?", *IEE Spectrum*, June 1997.

Now we must correct for antenna gain. Since our antenna is a dipole, its gain is 1.64 relative to a perfect point source. Also, our transmitter output is 40 watts. Our formula then becomes ERP = 1.64 x 40, and

$$E = \frac{\sqrt{30 \times 1.64 \times 40}}{D} = \frac{44.36}{D}$$

where E is the field strength in volts per meter and D is the distance from the transmitting antenna in meters. A plot of this curve is shown in **Fig. 1**. Also plotted are readings taken with a spectrum analyzer and a calibrated biconical antenna.

The transmitting antenna was a horizontal dipole cut for the two-meter band and tacked to a fence four feet above ground. The measuring antenna was also horizontal. It was mounted on a tripod four feet above ground.

The calculated and measured curves (**Fig. 1**) compare surprisingly well at distances of one and a half or more meters from the transmitting antenna. Is this dumb luck? Or perhaps a case of two wrongs making a right? Who knows? It should be noted that no correction was made for ground reflections. The transmitting and receiving antennas were both horizontal balanced dipoles. A series of readings at various heights above ground was taken with a hand-held E-field meter at a distance of two meters from the transmitting antenna. The results (**Table 1**) led us to believe that there was negligible ground reflection. The readings should be regarded as relative only. I don't trust hand-held E-field meters.

Now that we have a handy field strength formula, let's do some doodling. Suppose you buy one of those nifty 5 dBd (7.14 dBi) two-meter monopoles and mount it on the trunk lid one and half meters behind your child's car seat. There will be 100% ground reflection from the trunk lid. However, you can ignore it because the manufacturer is pretty sure to have included this in his advertised gain. Then antenna gain (7.14 dBi) is a factor of 5.18 power gain. Let's say you are running 40 watts output. The effective radiated power will then be 5.18 times 40, or 207 watts. So E =

$$\frac{\sqrt{30ERP}}{D} = \frac{\sqrt{30 \times 207}}{1.5} = 52.5$$

volts per meter at the child's car seat. The FCC limit for this frequency range is 27.5 volts per meter. However, we are allowed to do power averaging. If you are transmitting half of the time and listening half of the time, your average effective radiated power will be 207/2 or 103.5 watts. When we plug this into our formula we get 37.1 volts per meter. Still too high. (Power averaging over a half hour doesn't make sense to me.)

If we look at the curves (**Fig. 1**), we don't know which curve is more accurate, but the measured values appear to be. The calculated values seem to go wild at a distance of one meter or less. At a distance of one and a half meters, the calculated value was 29.5, whereas the measured value was 24.3. This ratio is 24.3/29.5 or 0.824. If we use this ratio to scale our reading of 37.1 volts per meter, we get 30.6. This is still above the FCC limit of 27.5 volts per meter.

Height (feet)	Volts per Meter
0	15
1	32
2	58
3	80
4	90

***Table 1.** Readings taken at various heights indicate the absence of significant ground reflection at a distance of two meters from the antenna.*

So what now? Since you own your car and since you know that your child is being exposed and you can legally speak for him, perhaps the car can be described as a "controlled environment." In that case, the maximum allowed field strength will be 61.4 volts per meter. Somehow this doesn't make me feel any better, but draw your own conclusions. Remember that according to the new FCC regulations, your mobile installation is exempt from evaluation for two reasons. First, you are running less than 50 watts transmitter output, and second, it is a push-to-talk mobile. 73

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And work it was! The Never Say Die editorials for the first four months of 1998 have been reprinted in larger, more easily readable type for you doddering old-timers. 82 editorial segments, without the usual gerrymandering through the magazine, and complete with an index. 1998 Volume 1 of the Secret Guide to being Healthy, Happy, Wealthy, and Wise runs 92 pages and is available for a measily five Federal Reserve Notes, which are worth every bit of the paper they're printed on.

Gluttons for mental exercise can invest $15 in the 1997 Collected Never Say Die Works, which runs to 240 pages. Just call Chris at 603-924-0058 with your Visa or MasterCard.

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continued from page 8

the years have come from amateurs just like you! Just get out that 35 mm camera with some color print film in it, get the shots in focus, and use a vertical orientation. And don't forget to stay back far enough from your subject to leave some room above and to the left of it for our magazine title and cover blurbs. No, you don't have to have the prints blown up. Just send us regular 4 x 6 color prints. Of course, the bigger the better, but normal will do just fine.

There's nothing to shoot. Right. How about Field Day? How about public service events, emergency operations, club meetings and activities? And while we do see a lot of shacks and antennas, those too can be winners—if the shot's formatted well, with a fresh look. Got any good DXpedition or portable or mobile shots?

Why not have some fun with it? Look for those great angles you get from climbing above or shooting from below your subject. Stage shots if you like (but be sure to tell us if that is the case). Make sure the sun is at your back. Be sure to use a flash if needed or even if you're in doubt. Let us see some recognizable human faces. Give the camera to the XYL or harmonic and let *them* shoot *you*. Or make a copy of this and take it to the local photography club or school class—maybe *they* could use some extra dough.

OK? The deadline is whenever you're ready, but be advised that sooner is better than later and increases your chances of acceptance significantly because you want to get your prints here before we book the upcoming cover schedule. But anytime could be OK.

Mail your color prints to Cover Shots, *73 Amateur Radio Today,* 70 Rte. 202N, Peterborough NH 03458. Be sure to include descriptions of what the shots are, and an SASE if you want the prints returned.

One more thing: If you're writing an article for us, be sure to take some cover possibilities to go with it! You increase its chances of being accepted, and you get more bucks if it is! And if you're not writing an article for us, why not? Just send for *How To Write For 73,* at the address above.

Who's Who in Ham Radio

Novice:

Makes high marks on the wall when trying to leap small buildings; is run over by locomotive; can sometimes handle a gun without inflicting self-injury; talks to animals.

Tech:

Falls over doorsteps when entering buildings; says, "Look at the choo-choo"; wets himself with water pistol; plays in mud puddles; mumbles to himself.

Technician (old):

Barely clears a Quonset hut; loses tug-of-war with locomotive; can fire a speeding bullet; swims well; is occasionally addressed by God.

Tech-Plus:

Runs into buildings; recognizes locomotive two out of three times; is not issued ammunition; can stay afloat with a life preserver; talks to walls.

General:

Leaps short buildings in a single bound; is more powerful than a switch engine; is just as fast as a speeding bullet; walks on water if the sea is calm; talks with God.

Advanced:

Leaps tall buildings in a single bound; is more powerful than a locomotive; is faster than a speeding bullet; walks on water; gives policy to God.

Extra:

Lifts buildings and walks under them; kicks locomotive off track; catches speeding bullets in teeth and eats them; freezes water with a single glance; *is* God!

Author unknown, reprinted in *NOARS LOG,* newsletter of the Northern Ohio Amateur Radio Society (November 1997).

The DXpedition

5:00 a.m.: Fellow DXers arrive. Crawl out of nice warm bed.

5:30 a.m.: Toss all gear into truck.

5:45 a.m.: Get gear out of neighbor's truck, put it in yours.

6:00 a.m.: Get speeding ticket while hurrying to get to the mountains.

7:15 a.m.: Arrive at "the site," near top of mountain.

7:16 a.m.: Start unloading gear.

7:20 a.m.: Get poked in eye with 20 m vertical by fellow DXer.

7:50 a.m.: Arrive at hospital to get eye patched up.

8:30 a.m.: Get another speeding ticket while heading back up to mountains.

8:45 a.m.: Arrive back at site. Unload antennas yourself this time.

9:45 a.m.: Hike up to mountaintop. Pass out from exhaustion.

9:50 a.m.: Wake up to smelling salts and laughter from fellow DXers.

10:00 a.m.: Put up antennas, and set up rigs.

10:15 a.m.: Fire up rig, call CQ for half an hour; no replies.

10:46 a.m.: Hook up coax to rig ...

10:48 a.m.: Realize that finals are wasted in main rig.

10:50 a.m.: Hook up backup rig, this time with coax.

11:00 a.m.: Yell CQ, rare VP8 comes back; antenna falls down ...

11:15 a.m.: Wake up to smelling salts, fellow DXers shaking their heads.

11:30 a.m.: Guy antennas.

12:05 p.m.: See long list of QSOs made by fellow DXers.

12:06 p.m.: Notice rare VP8 in logbook.

12:07 p.m.: Beat fellow DXer over head with logbook.

12:09 p.m.: Restrained by rest of DXpedition team.

12:30 p.m.: Back to rig for another attempt.

12:35 p.m.: Nearby lightning strike kills receiver. Notice wet pants ...

12:36 p.m.: Look for shelter.

12:38 p.m.: Find cave!

12:41 p.m.: Watch antenna get struck by lightning while hiding in cave.

12:42 p.m.: Wish it was fellow DXer's antenna, or him, that was struck.

12:45 p.m.: Realize you're not alone in cave ... smell bad breath of the ages.

12:46 p.m.: Pick up really big rock.

12:47 p.m.: Mauled by large angry bear.

12:50 p.m.: Get pulled out of cave by fellow DXers.

1:05 p.m.: Finally talked into receiving medical treatment.

1:30 p.m.: Arrive back at hospital.

1:55 p.m.: Receive series of painful rabies shots and multiple stitches.

2:30 p.m.: Get out of hospital and return home.

2:35 p.m.: Explain stitches and eyepatch to wife.

3:00 p.m.: Realize gear is still up on mountain, with bear.

3:01 p.m.: Wish fellow DXers were still up on mountain, with bear ...

3:03 p.m.: Consider taking up drinking.

7:00 p.m.: Get phone call from DXer buddies.

7:05 p.m.: Agree to go on DXpedition again tomorrow.

Lifted from the March 1998 *ARNS Bulletin*, which gave credit to the January 1998 issue of *Amateur Radio Horizons*, newsletter of the Lockheed Martin Employees Recreation Association ARC, Jim Woods KC7FG, Editor.

FCC Computer System Back On Line

The FCC has its amateur radio licensing computer system back on line. The wayward system sprang back to life on Friday, February 20th, and began processing the backlog of applications. The system went down on February 10th. No paper or electronic applications were processed for nearly 11 days as FCC personnel in Gettysburg attempted to troubleshoot the problems with the system.

Gettysburg personnel first processed data submitted on February 11th and 12th by VECs and had an updated file available for the Internet callsign servers on February 21st. Since the initial processing went well, VECs then sent on the applications they'd been holding back at the FCC's request. By February 26th, it was business as usual.

Gettysburg had caught up with the backlog and ran a batch of vanity applications, although a number of applications remained in the work in process stack.

The FCC offered no explanation for the computer breakdown, but did apologize to the nation's Volunteer Examination Coordinators for any inconvenience the breakdown might have caused.

TNX Bill Pasternak WA6ITF at *Newsline*, via FCC, ARRL, and Mike Mettler WW8MM of *Amateur News Weekly*.

Nominate the "Young Ham of the Year"

The nominating period for the 1998 Young Ham of the Year is open until June 30, 1998. Originally known as the "*Westlink Report* Young Ham of the Year," this award, now in its second decade, is presented annually to a United States licensed radio amateur who is 18 years of age or younger. Any continental United States (FCC licensed) ham radio operator 18 or younger who has used amateur radio to contribute to the benefit of the amateur radio service, the state of the communications art, their community or the nation is eligible to be nominated.

All nominations must be submitted before June 30 on an official application. Application forms are available for a self-addressed stamped envelope mailed to:

1998 Young Ham of the Year Award
c/o *Newsline*
28197 Robin Avenue
Santa Clarita CA 91350.

Six Meter Scholarship

The Six Meter Club of Chicago is offering a scholarship through the ARRL Foundation to any eligible college student who holds an amateur radio license and who resides in the "9" call district. Those interested in applying should write to:

The Six Meter Club Scholarship
c/o ARRL Foundation
225 Main Street
Newington CT 06111.

Another FCC Computer Glitch?

A New England ham is protesting an FCC mistake that reassigned his old callsign to another radio amateur before the end of the two-year waiting period.

The problem began when Ron Toller N1RT learned that the FCC had reissued his former callsign, WO4L, to a Florida man less than 12 months after Toller gave it up in 1996. The FCC's vanity rules state that callsigns will be held out of the pool for two years before being reissued.

Toller said a spokesman at the FCC's Gettysburg office blamed the premature release on a computer glitch. The same spokesman told the ARRL that by the time the FCC discovered its error, it decided not to rescind the grant, because of the number of licenses that had been granted by then, and the amount of time that had passed before the problem was discovered.

Toller's take on the turn of events differs. He says that if all the hams must obey the rules, so should the FCC. He says he's petitioning to have the FCC vacate WO4L until the two-year period is up in November. N1RT says that the commission has an obligation to adhere to its own rules and he wants the grant rescinded.

From the ARRL, via Bill Pasternak WA6ITF at *Newsline*. 73

Amplifiers, ATV Down Converters & Hard to Find Parts

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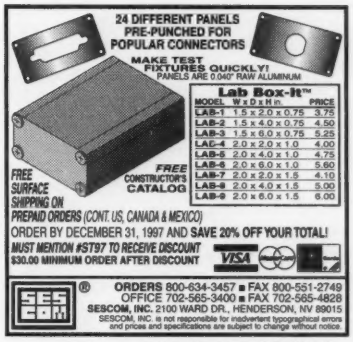
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ABOVE & BEYOND

VHF and Above Operation

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A surplus 1152 MHz synthesizer

Well, the SuperBowl will be over by the time you read this column, but for me things have been getting hot and heavy in videoland. I work for Pacific Bell video service here in San Diego and we are handling a large portion of the SuperBowl video operations. I'm jotting a few notes for this column while waiting for things to heat up, as it's some seven hours to kickoff and the suspense is mounting. San Diego is in turmoil and very active for a time and place that is supposed to be a sleepy Sunday morning in paradise. The weeks of preparation and work have all come to focus on just one moment in time, for big business and the football event of the year. Born and raised in Wisconsin, I'll always root for Green Bay—but as we know now, they did not win. It was a great game by all standards and very enjoyable in any case.

On to this month's material as promised: the conversion of a very high-quality synthesizer board from Qualcomm that is used as an excellent local oscillator or marker for 1152 MHz. This board, after conversion, can be used for several things besides a converter for 1296 MHz. Its main attribute is the ability to generate a very important frequency for amateur microwavers, 1152 MHz. This frequency is so important because it is the base prime number for a frequency stacking plan that is used to formulate all microwave frequencies.

The harmonics of a very accurate 1152 MHz source can be used as spot points of reference at the frequencies of 2304 MHz, 3456 MHz, 5760 MHz, and 10368 MHz—all the weak-signal microwave band operating frequencies. Even 24192 MHz is possible, as it is divisible by 1152 21 times. All the listed microwave frequencies are divisible by 1152 MHz. That means that if you have an accurate 1152 MHz reference source and have harmonics generated, you can produce a very accurate frequency marker spaced at 1152 MHz. This harmonic can be used to test receivers and provide assurance of frequency accuracy, removing a wobble in your microwave operation.

The synthesizer used in this project was obtained from Qualcomm, an equipment manufacturer of very high quality communications systems. The name Qualcomm is a composite of QUALity and COMMunications and correctly befits their equipment, which is very high quality. This surplus material that is made available comes from older systems being updated after many years of service. We purchase this surplus material and remove components and portions of the original system that can be used in amateur activities. By removing circuit boards and other devices from their original package, we ensure that no complete unit will come back to haunt Qualcomm.

Qualcomm is very gracious in that they allow us to utilize their material for amateur purposes. The main use is modification of portions of systems used for microwave communications. The modifications required to adapt to amateur operation are minimal. Without Qualcomm's cooperation and assistance, many scores of amateurs otherwise would not have had the opportunity to utilize such exotic and new state-of-the-art materials. (Please direct all questions concerning this material to me.)

The synthesizer PC board to be modified for 1152 MHz is larger than other synthesizers previously described. The main difference with this synthesizer is that its VCO functions at a lower frequency (in the 800 MHz range), while the VCOs in other units I have described work in the 2-plus GHz range. The basic synthesizer chip is similar in all units and capable of stand-alone operation to 1.6 GHz. In the 2.6 GHz synthesizer it has an onboard divide-by-two, allowing the synthesizer chip to function at 1.3 GHz while the local oscillator works at 2.6 GHz.

There are two different synthesizer chips used in this synth oscillator board. The later production chip, a CMOS version, is renumbered 3216 and identical to the original 3036 chip. The main difference is that the newer chip is a reduced-current CMOS unit drawing 150 mA less than the original 3036, which requires 400 mA for operation. The 3036 and this 3216 CMOS chip are interchangeable, being pin-for-pin compatible. The benefit with the newer 3216 is mainly that it is a much cooler chip that does not require heat sinking.

The conversion of a surplus synthesizer board begins with cutting pins 2, 5, 19, and 22 from their solder pads and gently lifting the pins up to ensure they are open. These pins are pulled high in logic with internal pull-up resistors. Be cautious that you do not damage other pins as you cut these pins—and only these pins. It's very hard to resolder a broken pin or a pin that is removed in error, as they do not like to be moved about much.

Cutting the pins is a one-time operation. Be sure to count the

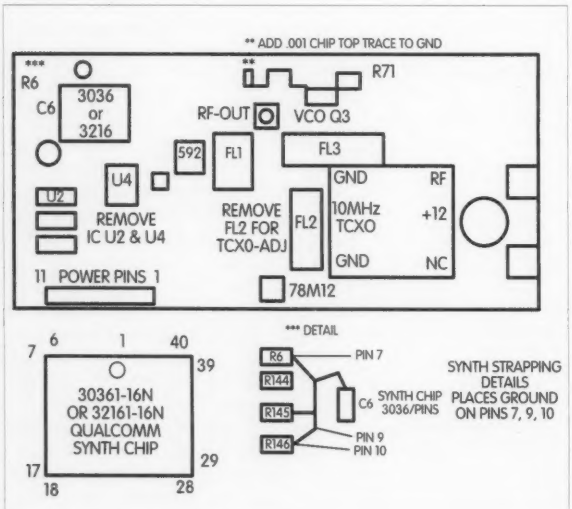

Fig. 1. *Block diagram of the Qualcomm synthesizer board. Originally intended for operation near 800 MHz, it is converted to 1152 MHz for marker or local oscillator use. Board size is 5 by 9-1/4 inches. It sports a high-accuracy onboard 10 MHz TCXO.*

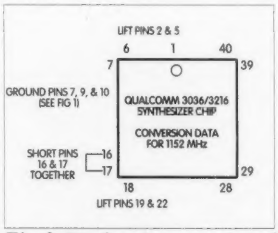
LIFT PINS 2 & 5
GROUND PINS 7, 9, & 10 (SEE FIG 1)
QUALCOMM 3036/3216 SYNTHESIZER CHIP
CONVERSION DATA FOR 1152 MHz
SHORT PINS 16 & 17 TOGETHER
LIFT PINS 19 & 22

Fig. 2. *Pin-for-pin conversion of Qualcomm synthesizer to 1152 MHz. Leave all other pins as they are.*

pins carefully—don't just throw caution to the winds and jump in. It's much easier to avoid a counting error by being careful and counting first than it is to retrace your counting steps, find an error, and have to correct it. Just as the old adage goes, measure a board 20 times but only cut once.

Next, several resistors to the top left of the synth chip—resistors R6, R145, and R146—are strapped together along their righthand side and tied common to the top of capacitor C6. See **Fig. 1** for details of operation. The resistors' right side is tied directly to the 3036 synth chip pins 7, 9, and 10, which need to be grounded. Tying them together and shorting them to the top of C6 grounds all these pins. C6 top is a direct ground connection and was available in the vicinity.

Additionally, pins 16 and 17 need to be tied to ground. Short with a solder bridge pin 16 to pin 17 to satisfy pin 16's being grounded, and then wire pin 17 directly to ground. Next, ICs U2 and U4, as shown in **Fig. 1**, need to be removed from the PC boards. Cut all the pins on one side of either chip. Lift and break off the remaining side by flexing the chip about. After the chips are removed, you can use Solder-Wick™ to remove the pins still attached to the PC board for final cleanup or leave the pins where they are, as long as nothing is shorting out.

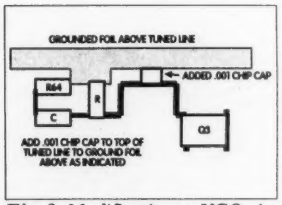
GROUNDED FOIL ABOVE TUNED LINE
ADDED .001 CHIP CAP
R64
R
C
Q3
ADD .001 CHIP CAP TO TOP OF TUNED LINE TO GROUND FOIL ABOVE AS INDICATED

***Fig. 3.** Modification to VCO circuit on synthesizer board to convert original VCO frequency from 800 MHz range to 1152 MHz. Add .001 µF chip capacitor from top of printed inductor to ground. This bypass capacitor increases VCO frequency from 700 MHz to 1200 MHz.*

The VCO is the last item to be converted to our new operating frequency. Normally it runs in the 800 MHz region. As is, it will not pull up to 1152 MHz without modification to its circuitry.

The modification is quite simple and shown in **Fig. 3.** Locate the Q3 transistor just above the RF output coax connector. Going off to the right of Q3 is a stripline inductor which is the 800 MHz VCO tuned line. To convert it to 1152 MHz, place a chip cap on the top center of the tuned line and solder it to the ground foil just above the tuned line. Solder the other end of the capacitor to the center of the top tuned line as shown in **Fig. 3.** This bypass capacitor increases the tuned line to resonate in the 1 to 2 GHz region and is not critical.

Check all work operations for solder bridges and obvious shorts after conversion is complete. Check the power pins (1 to 11) on the power connector. Pins 1 and 2 are the +15 volt DC input. Pin 3 is PC board ground, and pin 4 is +5 volts DC. There is an onboard voltage regulator from the +15 volt line to 12 volts regulated. Its location is just below the FL2 and is labeled 78M12.

If you want the most accuracy and can verify that the 10 MHz TCXO oscillator is set to exactly 10 MHz, remove FL2 with a pair of pliers by breaking it off the PC board. I had great trouble in trying to remove this filter with a high wattage soldering iron and do not recommend unsoldering it. Instead break it off with an easy twisting as this puts less strain on the entire PC board.

Once the FL2 is removed, you can now get access to a small patch of aluminum tape on the side of the TCXO. Removing this tape gains you access to the Johanson VCO trimmer crystal adjust capacitor. Adjusting this capacitor will allow you to set the oscillator to precisely 10 MHz. Replace the foil tape when completed. This keeps internal circuitry somewhat insulated from drafts, which can affect the internal circuitry directly.

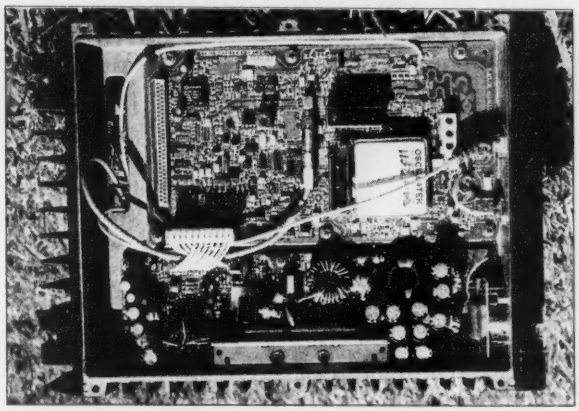

***Photo A.** Completed 1296 transceiver using 1152 synth board. Unit power supply is at bottom and 1152 synthesizer above. 3036 synth chip at upper left. Large silver-colored unit near middle right is the high-precision 10 MHz TCXO. Synth PC board size is 5 by 9-1/4 inches.*

Power up the synthesizer and observe a small LED just above pin 1 on the 3036 synth chip. While turning on power this LED should briefly turn on, the extinguish indicating phase lock is good. Trust me here: If the LED is out, the frequency output is

Continued on page 52

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almost exactly 1152 MHz and can only be off if the 10 MHz reference is way off frequency.

Power output can be taken from monitor coax connector, or a short piece of miniature coax can be soldered to this connection for test connections. Output power available from this coax connector is about zero dBm. Power can be increased by running through an external MMIC amp or further modification to the MMIC in the transmit section of this PC board.

A further modification is to connect the coax connector to the MMIC amp in the upper left corner and use it for an additional 12 to 14 dB of gain at 1152 MHz. To use the MMIC onboard op amp, cut the input and output traces on the PC board and with +12 volts to the resistor feed for the MMIC amp. Connect the coax connector to the input capacitor of the MMIC and tie another short section of coax cable and connector to the output. You should obtain about +14 dBm for converter or harmonic drive using the MMIC to amplify the VCO signal.

Now that the unit is finished, it can be mounted in a suitable metal box with its power supply—be it 12 V DC or 110 V AC. This unit can be brought out in two different levels, the first being the low-level 1152 MHz at the coax connector just below the VCO transistor (Q3).

The second output, the high-level from the MMIC amplifier, is brought out to a coax connector for easy connections. A simple harmonic amplifier can be adapted for use by taking a common 3.7 to 4.2 GHz LNA amplifier and removing the waveguide flange and input circulator (with band saw or hacksaw, as necessary). Add a 10 pF chip capacitor to the input stripline and place a coax connector on the other end of the capacitor to isolate the amplifier input with the capacitor.

Take an X-Acto™ knife and cut away all the tuning stubs on the main stripline, making the amplifier broadband in nature. Do not cut the voltage feed RFC very narrow lines feeding the gate and drain leads. When finished, the TVRO LNA is now very broadband in nature over some 3 GHz or more of frequency, from 800 MHz to over 4 GHz.

Driving the input of the LNA with the zero dBm port, the amplifier will be driven into saturation, making it rich in harmonics at which output will occur. With 1152 MHz input there will be 2304 MHz, 3456 MHz, and 5760 MHz output markers. The high level port (+14 dBm port) can be used to construct a 1296 MHz transverter.

Add a mixer and inject with 1152 MHz for the local oscillator, and with a 144 MHz IF you are now on 1296 MHz multimode or whatever your rig at two meters can function at. Add a receiver preamp and power stage for transmit and that's all there is to it.

The local oscillator seemed to be the stumbling block for many amateurs in constructing a building block system for microwave operation. Now we see that the frequency can be quite pure and extremely accurate even when a scheme is used to separate the harmonics and use them for injection with suitable filtering and amplification to a specific frequency of use. Just imagine a single local oscillator generating a single frequency and being used to function at other frequency bands as an accurate local oscillator.

It's all possible, just as it is up to your imagination to figure out just what you want to construct to function in the microwave realm. This unit will provide a very stable, accurate marker, so its prime use toward this end can be accomplished. I am very satisfied with its operation, and even finished the 1296 MHz rig at a low power transmit level. Soon, I plan to increase the power to about two watts.

If making a similar marker for your workbench or field microwave use interests you, I can supply you with one for $75 plus $4 postage. If you want a unit that is converted (modifications done) and ready for adding external connections, add $40. I will make a limited number of units available in this converted manner to help those without test equipment that functions in the frequency range.

Next month, I plan to answer reader questions that have been

Continued on page 53

1152 MHz Board

VCO Freq MHz	1152							
Ref Freq MHz	1							
N	1152							
		R149	R148	R147	R146	R145	R144	R6
		M6 (pin 15)	M5 (pin 14)	M4 (pin 13)	M3 (pin 10)	M2 (pin 9)	M1 (pin 8)	M0 (pin 7)
M	114	1	1	1	0	0	1	0
Board as is		1	1	1	1	1	1	1
		A3 (pin 21)	A2 (pin 20)	A1 (pin 19)	A0 (pin 18)			
A	2	0	0	1	0			
Board as is		0	0	0	0			
		R3 (pin 5)	R2 (pin 4)	R1 (pin 3)	R0 (pin 2)			
R	9	1	0	0	1			
Board as is		0	0	0	0			
Pin 22	1							
Board as is	0							

Table 1. *Spreadsheet calculations ("3216 PLL Calculations," K. Banke N6IZW, 11/22/97) show original pinouts (board as is) and conversions needed for the "M", "A", and "R" counters, as well as the MODE pin 22. Additional instructions: Ground R150. Ground right side of R6–R150 as required. Remove U2, U4. Add 1000 pF at Q3 symbol. Power: J2-1, +15 V; J2-3, GND; J2-4, +5 V. Output: TP1. Remove FL2 to access 10 MHz ref freq adjust.*

Hams with class

Carole Perry WB2MGP
Media Mentors Inc.
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Staten Island NY 10313-0006

NASA activities

A great source of highly motivational lessons to use in a ham radio classroom or as part of a science curriculum is the Educational Division of NASA. Many of the lessons about the atmosphere are directly applicable to the lessons we teach to promote understanding about radio wave propagation. The whole approach used in their activity guides is one of investigative inquiry. It's really very well done and can be adjusted to various age groups in the classroom.

I'll share with you two of the lessons that have been used successfully by my 6th, 7th, and 8th grade radio classes at Intermediate School 72 in Staten Island NY. The lessons' theme is "The Mysterious Atmosphere."

What is the atmosphere? Scientists believe that millions of years ago our planet had a very thin atmosphere, which gradually became a protective blanket that maintained warmth and provided the necessary gases for life to evolve. Air bubbles in columns of ancient ice tell researchers that only 100,000 years ago—a brief moment in Earth's long history—our atmosphere was much different than it is now. Why has the atmosphere changed? How have changes in the atmosphere and weather affected life on Earth? Was weather related to the disappearance of giant dinosaurs? What is causing changes now? Will these changes have drastic effects? All of these are mysteries.

What do you know about the atmosphere? Wave your arm around quickly. Did you feel anything on or behind your hand? What you felt is air—our atmosphere. It surrounds us like an invisible ocean of gases and particles; it has no definite boundaries but extends outward from the surface of Earth for thousands of miles. Most of us think of the atmosphere as just air, but it works as part of an intricate system that includes the Sun, Earth's oceans, and land surfaces, each influencing the others. We know much about the atmospheric system, but some of the ways in which the atmosphere, the oceans, and the land interact and change are still mysteries. For this reason, scientists travel Earth and into space to search for answers.

Investigation 1

Here are some activities to help you discover important characteristics of the lower atmosphere. Does air have weight? Your guessed answer is called a hypothesis. Now you test that hypothesis with an experiment. You'll need two small latex balloons, two pieces of string (each 15 cm long), a 30.5-cm ruler, a sheet of notebook paper, and tape.

Procedure

Attach a balloon to each end of the ruler, being careful to use exactly the same lengths of string or tape to attach each balloon. Suspend the ruler on a string at approximately the 15-cm mark to create a balance. With tape, attach the top of the string to a wall at about eye level. Tape the notebook paper to the wall behind the ruler. Put a pencil mark on the paper above and below each end of the ruler to mark its beginning position. Remove one of the balloons and blow into it, inflating it as much as possible. Tie and reattach the balloon with the same piece of string. Gently pull the string suspending the ruler away from the wall, allowing the ruler to readjust. Carefully release the string and check the ruler's new position. Mark the paper with the pencil again. Questions: 1. Does the ruler still balance? 2. Does one balloon now weigh more than the other? 3. What does this tell you about air? 4. Was your hypothesis correct? When a number of different experiments give the same results, the hypothesis may be accepted as a theory.

Investigation 2

Here is another investigation that the kids really enjoy doing because it can be set up as a "hands-on" for everyone in the class. Earth's magnetic fields are not visible to the naked eye, but when particles moving toward Earth interact with gas in the upper atmosphere, the light produced is sometimes visible as auroras. These are also called northern and southern lights. You can get a general idea of the shape of the magnetosphere from this investigation.

Materials needed: about 0.05 g of iron filings (a pad of coarse steel wool can be cut into fine pieces to substitute for iron fil-

Continued on page 54

Above & Beyond

continued from page 52

piling up and describe various bits and pieces for microwave operation. The questions, mainly, are: If it's for microwave and it works on the frequency I want, do I need it? And what problems will it help me solve? Well, there you have it for this month. 73, Chuck WB6IGP. 73

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Receiving loops & loop preamplifiers: part 2

As discussed in part 1 last month, the output signal levels produced by loop antennas are typically very low. The use of a tuning capacitor can increase the levels by 10 to 200 times, but even these levels are often below what is needed. To overcome this problem loop users often provide a preamplifier to boost signal before sending it to the antenna input terminals of the receiver. Before looking at specific designs, let's take a look at the various amplifier-loop configurations.

Amplifier-loop configurations

The basic amplifier configurations are single-ended and balanced. The single-ended amplifier has only one input terminal and ground. The signal is applied between the input and ground. The balanced amplifier, which includes both push-pull and differential amplifier designs, uses two inputs. The amplifier responds to the difference between the signal applied to the two inputs.

Fig. 1 shows the most basic single-ended amplifier and loop configuration. The loops in

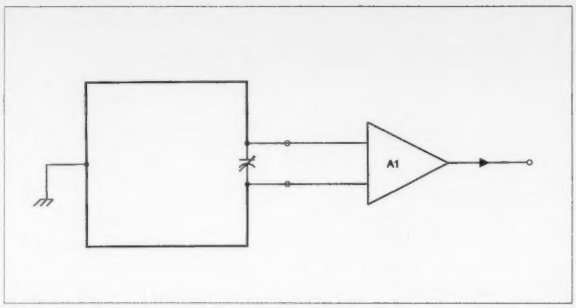

Fig. 1. Basic single-ended loop amplifier.

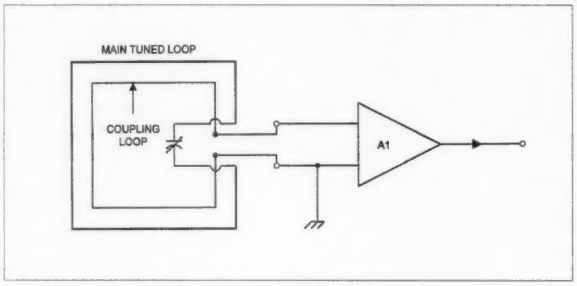

Fig. 2. Single-ended with coupling loop.

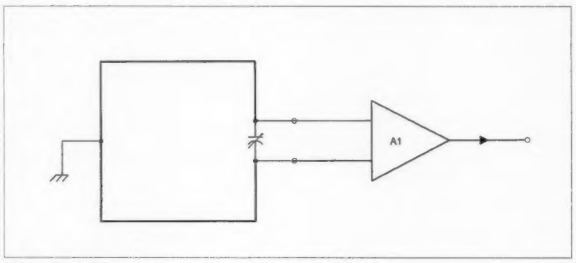

Fig. 3. Balanced loop.

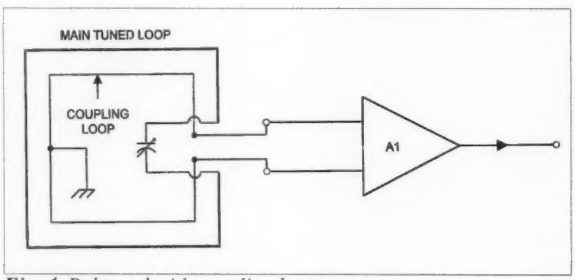

Fig. 4. Balanced with coupling loop.

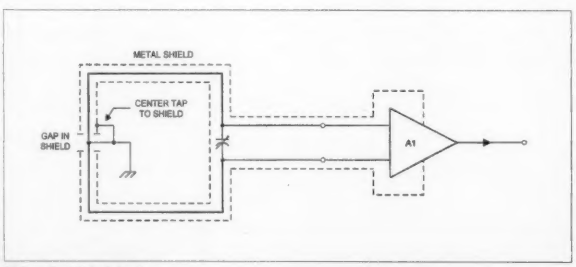

Fig. 5. Shielded.

HAMS WITH CLASS

Continued from page 53

ings), heavy white construction paper, and a bar magnet.

Procedure

Measure the length of the magnet. On the paper, draw a circle with the same diameter as the length of the magnet. This will represent Earth. Mark the top of the circle "North" and the bottom "South." Lay the bar magnet on a flat surface such as a table. Place the paper over the magnet so that the ends of the magnet are on the "North" and "South" marks. Sprinkle the filings over the paper. Gently tap the paper, allowing the filings to move. Keep tapping until the pattern stops forming. 1. How can you tell where Earth's magnetic poles are? 2. What do the lines formed by the filings represent? 3. Look in an atlas to locate Earth's geographic poles. Are they in the same place as its magnetic poles?

A good place for an educator to get started with useful materials to use in the classroom is with CORE. This is NASA's Central Operation of Resources for Educators. CORE was established for the national and international distribution of NASA-produced educational materials in audiovisual format. The address is:

NASA CORE
Lorain County Joint
Vocational School
15181 Route 58 South
Oberlin OH 44074
Phone: (216) 774-1051 ext. 293

Let's all remember that sharing good instructional ideas is what the "Hams With Class" column is all about. Please send me any teacher-tested things you've had success with. Include photos and we'll highlight your children having fun with ham radio. 73

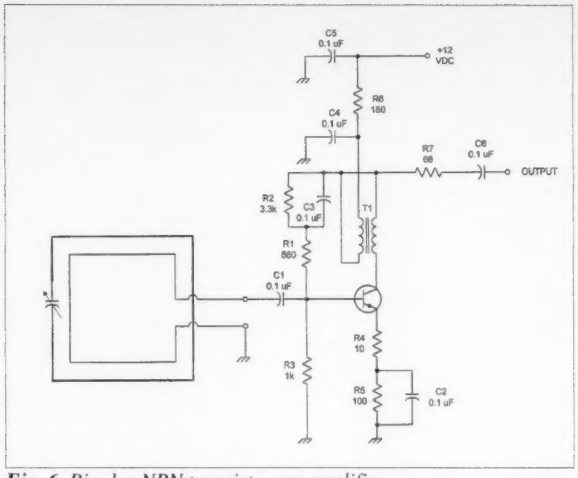

Fig. 6. Bipolar NPN transistor preamplifier.

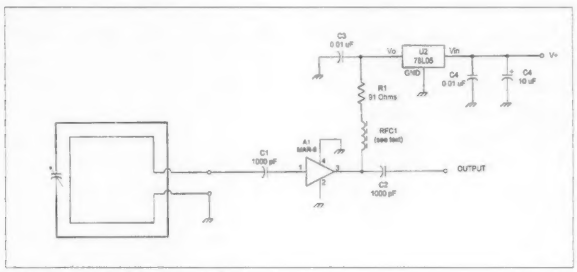

Fig. 7. MAR-6 preamplifier.

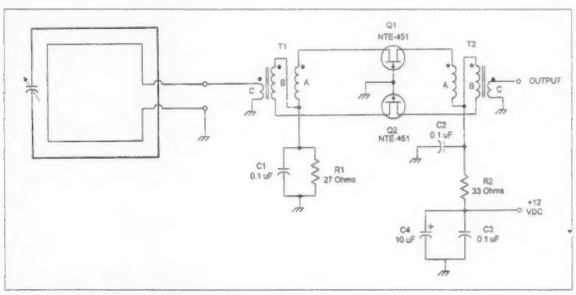

Fig. 8. Push-pull JFET preamplifier.

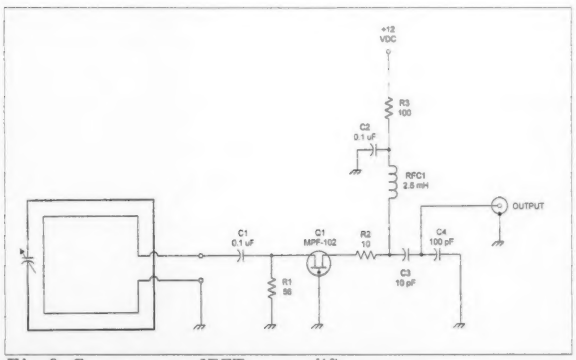

Fig. 9. Common gate JFET preamplifier.

Figs. 1–5 are shown as single-turn loops, but that is a graphical convenience, and both single-turn and multi-turn loops are intended. The loop is tuned by a capacitor. One end of the loop and the loop winding is grounded, as is one terminal of the amplifier input. A variant circuit is shown in **Fig. 2.** The version in **Fig. 1** uses the main loop to provide signal directly to amplifier A1, while the variant version of **Fig. 2** uses a coupling loop (magnetically coupled to the main loop) to provide signal to the amplifier. Both are single-ended, but in one case the main loop is used and in the other a coupling loop is used.

A balanced loop is shown in **Fig. 3.** This type of loop is center-tapped and the tap is grounded. This provides genuine balanced input for the differential preamplifier, A1. The same idea using a coupling loop is shown in **Fig. 4.**

Shielded loops are often used to eliminate pattern distortion due to capacitive coupling between the loop and its environment, and interference to reception due to local electrical fields. In **Fig. 5**, the loop, the tuning capacitor, and the amplifier input circuitry are Faraday-shielded by a metal barrier. A gap in the shield allows the loop to respond to the magnetic field component of the radio signals. If a center-tapped loop is used, then the center tap will be grounded either at the gap or close to the output (provided that it is electrically at the center of the loop). Tapping the loop at the output side is more convenient on multi-turn loops, while on single-turn loops the gap method is used.

Single-ended amplifiers

Fig. 6 shows the circuit for a simple preamplifier based on an NPN transistor connected in the common emitter configuration. The type 2N5719 is most often used in this circuit. Two negative feedback methods are employed in this circuit. One is an unbypassed portion of the emitter resistance (R4), and the other is transformer T1. The negative feedback serves the purpose of reducing distortion and smoothing the frequency response characteristic. This amplifier is normally used from 3 to 30 MHz, but with suitable selection of transformer and capacitors a different range can be accommodated.

The unique thing about this circuit is that it has a 50 ohm input impedance and a 50 ohm output impedance, and so will interface nicely with the coupling loop and the antenna input of the usual receiver antenna input.

Another single-ended amplifier is shown in **Fig. 7**. This circuit is based on the Mini-Circuits MAR-6™ integrated circuit amplifier. It is a low-noise amplifier that provides about 20 dB of gain over the frequency range of from near-DC to 1,000 MHz. Capacitors C1 and C2 are used to couple signal into and out of the amplifier, while blocking DC.

The DC power is applied to the MAR-6 integrated circuit through the output terminal. The DC path includes R1, which limits current, and RFC1, which peaks the gain at high frequencies. The DC source voltage is supplied through a low-power 78L05 100-mA, five-volt, three-terminal voltage regulator.

The RF choke (RFC1) is used as a peaking coil, and is optional in some applications. The usual practice is to provide a 1 µH inductor for this purpose. In higher frequency amplifiers (VHF and above), the RF choke might be replaced by a ferrite bead slipped over a short piece of #22 or #24 hookup wire.

The amplifier in **Fig. 8** uses a push-pull circuit to improve dynamic range and reduce distortion, but from the loop's point of view it is single-ended. The single-endedness is provided by the input transformer, T1. Windings "A" and "B" are used to drive the emitters of the JFET transistors (Q1 and Q2). Winding "C" is used to couple to the

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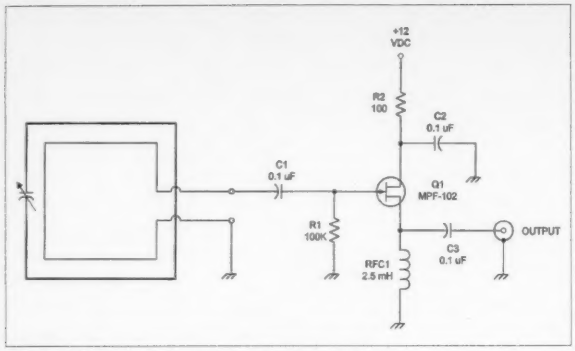

Fig. 10. Common source JFET preamplifier.

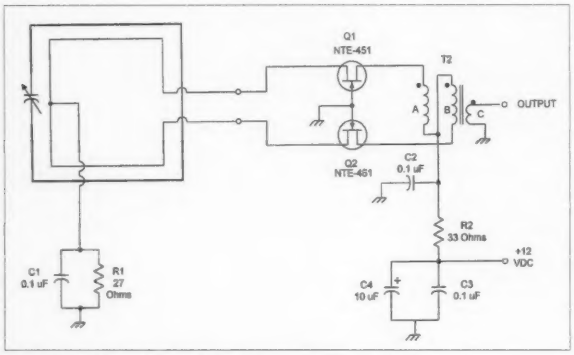

Fig. 11. Loop integrated push-pull preamplifier.

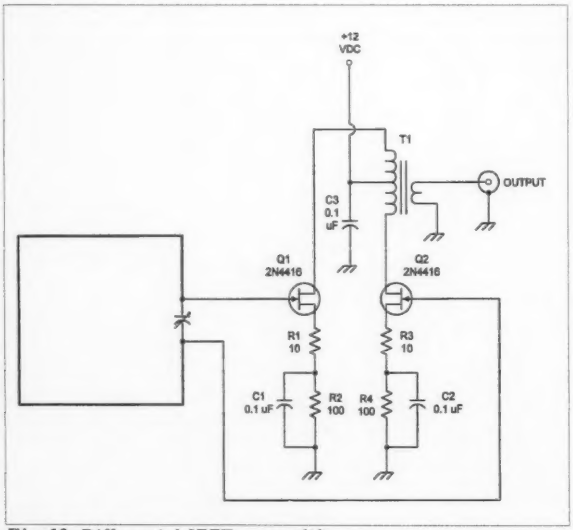

Fig. 12. Differential JFET preamplifier.

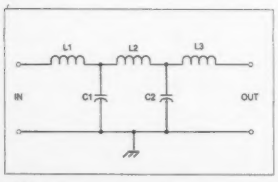

Fig. 13. Low-pass filter.

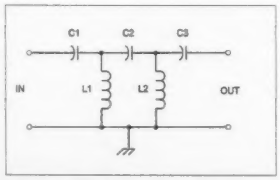

Fig. 14. High-pass filter.

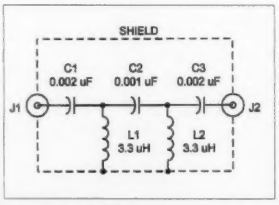

Fig. 15. Compromise.

CARR'S CORNER

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loop. If the coupling loop of the antenna is used (as shown), then winding "C" is a low-impedance winding. If, on the other hand, the main loop is used, then the impedance of winding "C" must be higher. Windings "A" and "B" must match approximately 1,000 ohms, while T2 must match 1,700 ohms.

The transistors used for the circuit of **Fig. 8** are either 2N4416 devices, or the service replacement equivalents NTE-451 and ECG-451.

A slightly different design approach is used in **Fig. 9**. The amplifier device is an MPF-102 JFET device connected in a common gate configuration. Signal is applied across the source-gate terminals, while output signal is taken across the drain-gate terminals. Because this circuit is inherently low impedance, it is used with the coupling loop approach to antenna design.

Capacitor C1 is used to block DC bias, provided by the voltage drop across R1, from being shorted to ground through the loop. The output circuit consists of a capacitor voltage divider, C3/C4. This circuit matches the relatively high impedance of the Q1 drain to the 50 ohm antenna input used by most receivers.

Another JFET preamplifier is shown in **Fig. 10**. This circuit uses the same device (MPF-102) as the previous circuit, but in the common drain configuration. The signal is applied across the gate-drain terminals, while the output signal is taken from the drain-source terminals. The source circuit, which is used as the ~~output,~~ has a series-connected RF choke. This part keeps the source terminal at a high impedance for RF, while allowing it to complete the circuit for DC.

Balanced amplifiers

An example of a balanced amplifier is shown in **Fig. 11**. This circuit is a variant on the theme of the **Fig. 8** circuit in which the input transformer (T1 in **Fig. 8**) is replaced by the loop. Because the circuit is a common gate push-pull amplifier, the coupling loop must be center-tapped in order to provide balanced (but out of phase) input signals to Q1/Q2. As with the previous version, the DC is applied to the drain terminals of Q1 and Q2 through the windings of output transformer T2.

A common-source differential amplifier is shown in **Fig. 12.** The active devices, Q1 and Q2, are 2N4416 JFET transistors. Source bias is provided by resistors R1/R2 for Q1 and R3/R4 for Q2. A small amount of negative (degenerative) feedback is provided by unbypassed source resistors R1 and R3.

The output side of the circuit uses a push-pull transformer (T1). Such transformers are center-tapped. The DC power is applied to the center tap, and then routed to Q1 and Q2 through the windings of the transformer. Because of the center-tapped loop, and center-tapped output transformer, Q1 and Q2 operate out of phase with each other.

Input filtering

One of the more difficult to solve problems in radio receivers is overload from out of band signals. The frequencies that are most often used with loop antennas are often subject to strong overload from AM broadcast band stations, local amateur radio stations, and other transmitters. These signals can cause problems in the receiver even if they are not heard in the output, and thus need to be eliminated. When a preamplifier is used between the receiver and antenna, the problem is only made worse.

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On the Go

Mobile, Portable and Emergency Operation

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Sometimes people wonder if your ideas and suggestions are noticed. Trust me, your thoughts are the best inspiration. For example, I received an E-mail message from Walter K5KNE, who offered some real food for thought about emergency communications. He pointed out that many hams are interested in being of service in an emergency, but are not affiliated with any public service or other emergency agency. They expect to show up when an emergency occurs and be of assistance. As Walter put it, "The average well-intentioned ham doesn't realize that he is just another sightseer with a radio—unless he has a 'real job' with a responding agency." I've been thinking about his comment for the past few weeks as much of the nation has been facing *El Niño* weather problems. In my area SkyWarn has been activated a number of times as rain and high winds have led to flooding and several tornadoes.

Our SkyWarn system works pretty well, with one ham acting as net control, while another works with the weather bureau, and the majority act as spotters spread throughout the county. As the meteorologists at the National Weather Service become aware of developments or see a suspicious radar image, they may ask if anyone in that area can actually see and accurately describe the conditions. The SkyWarn weather spotters are one more data point the weather experts use to make a forecast. If a watch (conditions which are conducive to developing into a particular type of storm) or a warning (the storm, such as a tornado, has actually been observed) is declared, that information is then released to the public through local radio and television stations.

In many cases, though, well-meaning hams *do* act as sightseers with radios. There are the inevitable fair weather reports, or a report to the net that a television station is broadcasting a particular forecast. As amateurs we know that a signal can be lost if the noise level rises; much of what is being transmitted is noise and nothing more. What this says to me is that these folks desperately want to be involved in order to help out, but they don't have a specific function assigned. In their attempt to help out they are at significant risk of making matters worse. Imagine if our firefighters or police officers responded with the proper equipment, the best of intentions but no clear understanding of precisely what they needed to do or to whom they would report. As the old saying goes, "If you're not part of the solution, you're part of the problem."

The key is to know exactly what you're expected to do, for whom, well in advance of the emergency situation. Area coordinators for disaster services need to prepare with this perspective rather than assume that people will be identified, located, assigned and trained in the moments after a disaster hits. Individual hams need to find out what roles they can expect to play. Since there are so many, a well-informed ham can review the possible assignments, and then apply or lobby for one of those which looks interesting.

How do you determine what is available? Obviously, experience is the best teacher, or you can talk with someone who has been involved in emergency communications for a number of incidents. To get a more global perspective you can turn to a number of books addressing disaster communications which have been published in the past few years.

Among those that are general in nature, *Guide to Emergency Survival Communications*, by Dave Ingram (Universal Electronics), is a fun book to read. It is aimed at those who want to "receive accurate and timely information in time of crisis." These are non-hams and potential hams, but the book reminds us of how many people will be listening in on our efforts to support an emergency. The preface details how Murphy's law is paramount in disaster communications.

When the Big One Hits ..., by Jerry Boyd KG6LF and Jay Boyd KN6BP (World Radio Books) is more amateur radio-oriented and addresses specific types of disasters. It gives straightforward guidance to

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Carr's Corner

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The usual (and most effective) method for eliminating these problems is to put a filter either ahead of the preamplifier or between the preamplifier and receiver antenna terminals. Even if no preamplifier is used, if a problem is experienced then the filter can be used between the antenna and the receiver.

Figs. 13 and **14** show the low-pass and high-pass filter circuits, respectively. The low-pass filter passes frequencies below its -3 dB cut-off frequency. Such filters might be used on an LF or VLF receiver to prevent overload from AM BCB stations. In Europe, where both the medium wave (0.520–1.710 MHz) and LF band (145–280 kHz) are used for AM broadcasting, the problem is especially severe. Such cases may require two filters.

These filters are designed for 50-ohm input and output impedances, which is the standard impedance for most RF systems. The values for the components in **Figs. 13** and **14** are found by dividing the following constants by the desired cut-off frequency in megahertz (MHz). For the low-pass filter (**Fig. 13**): L1 constant = 5.6; L2 = 10.6; L3 = 5.6; C1 = 3300; C2 = 3300. For the high-pass filter (**Fig. 14**): L1 constant = 5.36; L2 = 5.36; C1 = 3900; C2 = 1800; C3 = 3900.

For example, suppose we want to design a high-pass filter to prevent AM BCB signals from overloading a medium wave shortwave receiver (3 to 7 MHz). We might select a -3 dB cut-off frequency of, say, 2 MHz. The component values for the high-pass filter then would be:

C1 = 3,900/2 = 1,950 pF
C2 = 1,800/2 = 900 pF
C3 = 3,900/2 = 1,950 pF
L1 = 5.36/2 = 2.68 µH
L2 = 5.36/2 = 2.68 µH

A slight variation on the theme is shown in **Fig. 15.** This circuit is a "practical" compromise that allows the use of standard value components. The capacitors are 0.001 µF and 0.002 µF units, both of which are standards. The 0.002 µF capacitor can be made by paralleling two 0.001 µF units, if desired. The 3.3 µH values for the coils are a standard value. Although they can be made from toroid core and a bit of wire, these coils can also be purchased from Toko™ dealers and other sources. 73

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QRP

Low Power Operation

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As the sun warms the planet this time of year, spring arrives and once again the earth is renewed. It's also the time of year that marks the beginning of hamfest season! And of course the biggie that starts the season off is Dayton's hamvention®. With luck, this year will mark my 24th trip to Dayton. And if my timing is correct, the column should hit just as the hamvention kicks off.

Dayton is a place to spend money. It's as simple as that. I know I save all year long just so I can spend my money on something I really don't need. So, having said that, let's look at some of the QRP rigs and some price guidelines.

A word of caution may be in order. I've gathered these prices from hamfests I've been to in the past as well as from classified ads and CompuServe's HamNET forum. They're not carved in stone, but are meant to serve as a guide in your purchases. These prices may save you some money or if you're the one doing the selling, make you some money.

It's also a sure bet that the hamfest sellers have increased their prices, knowing the buyers will haggle them down. It's all a game—and if it's played correctly, both parties come away happy.

Know your abilities

If you're looking for a radio, are you able to repair it, if it's broken? Some of my best deals came from buying rigs from the hurt locker. My absolute best deal ever was an Argonaut 509 for $15.00 (of course, when I picked the rig up, parts fell out of the case). Even if you can fix the rig, are replacement parts available? If so, are they expensive? Some of the classic QRP rigs are hitting 25+ years old. Many of the cosmetic parts are no longer available at any price.

If you can't fix it yourself, you'll have to *pay* someone who will. Keep that in mind when you're out looking for rigs.

How about manuals? Lost or missing manuals will be a gotta-have if the rig is kaput. I've been told that the prices of some manuals from Heathkit are very, very expensive (try $50 for an HW-99 manual). If the rig you're after has all the manuals, you'll pay for them, as the price is usually part of the overall deal. On the other hand, if the manual is missing, this might give you some leverage when haggling.

Dead ham rigs

By buying from an estate sale, you're getting someone else's gear without the benefit of knowing anything about its history. Such questions as "Does it work?" or "When was the last time it was on the air?" are important—but there's usually no one available who can answer these questions. Some of the stuff may have been sitting for years in storage since the old guy died in 1978, and his wife died last year—so it's possible the HW-7 has been sitting untouched for 20 years.

Everyone wants a bargain but buying from an estate can be a bit tricky. Most widows want the maximum bucks from the old man's stuff. Most will quote a selling price as the same as the purchased price when new—27 years ago! On the other side of the coin, the people standing on the opposite side of the table will offer the widow pennies on the dollar.

If you're the one selling and have no idea what the stuff is worth, get hold of someone who *does* and price the gear accordingly. If you're doing the buying, offer reasonable prices for the stuff.

Heathkits

Since we talked about Heathkit rigs several months back, it seemed fitting to start here.

Heathkit made three QRP rigs: the HW-7, HW-8, and the HW-9. The HW-7 and HW-8 sport direct conversion receivers. The HW-9 has a superhet receiver and would (provided the WARC band kit was installed) cover the WARC bands.

You can pay anywhere from next to nothing for an HW-7 in good shape to about $125. Because the receiver in the HW-7 sucked, mostly collectors seek out this rig. If the guy on the other side of the table has a mint HW-7 and knows he does, I've seen asking prices of over $225 for one.

The HW-8, on the other hand, is still quite sought-after and there are thousands of them working the lower end of 20 meters. Expect to spend from $80 to about $150. The only option the HW-8 had was a small power supply. Figure about $10 to $25 more if the supply is included.

The HW-9, on the other hand, seems to demand a rather high price. There were several options for this rig, including the WARC band kit, a wattmeter and an antenna tuner. An HW-9, with the WARC band kit, around $175 to $250. Options will of course drive up the price. A lot of HW-9s had dial slippage problems as well as stability

On the Go

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various aspects of emergency communications, including an analysis of various disasters and how hams could be involved.

The book that I keep in my emergency bag is *ARES Field Resource Manual* (ARRL). This book is useful because it has forms which you complete with frequencies, telephone numbers, names, etc. In this way it can be a training manual as well as a reference manual in the field. I replace my copy periodically because it will get dog-eared and stained through use. It is definitely the most specific book I've seen, since you fill in the blanks after you buy it, which is also helpful in identifying possible duties.

After looking at the options, decide where you wish to work in an emergency. You could be with the Red Cross damage assessment team, or at an emergency shelter. Does your city or county have people assigned to the police and fire department communications services? What about working with the folks who provide food for the rescue teams? Will the local hospital need additional communications support? Doesn't it make more sense to choose what you want to do, train to do it and get to know your potential co-workers well in advance? Even if you are the rare individual who can do it all, some jobs are going to be better than others. Wouldn't you prefer to have some choice in the matter rather than be assigned whatever is left over?

Emergency communications is a skill that must be properly learned and properly practiced. This is why it is important to have a good overview of how disasters are managed, and more important to know precisely what you will be called upon to do and for whom. When an emergency hits and you report to your agency, the response should be, "Thank goodness you're here," not "Who the heck are you?" Be an asset rather than a sightseer with a radio. 73

problems on 10 meters. Ask the seller if this rig had those faults.

Ten-Tec

Ten-Tec got their start by selling QRP modules. They have a widely varied selection to choose from—the PowerMite series have become classics. The PM1 and PM2 are sought out, not so much as operating rigs, but as collector items. A clean PM2a can fetch upwards of $200. But many hams who own a PM2 don't know its real value. As of last year at Dayton, two were sold at the Day's Inn™ for $35 each!

Ten-Tec also sold a receiver-only rig known as the RX10. While perhaps not exactly QRP, demand has made them expensive. Expect upwards of $400 for an RX10. Ten-Tec also made a matching transmitter for use with the RX10. I've only seen one of these in my many years of hamfests. If I recall, the Ten-Tec designation was the TX10.

The Argonaut

Clearly these rigs by Ten-Tec are in demand today both by the collector and rag-chewer.

The Ten-Tec 505 was the first in the series. As with all the Argonauts, the 505 supports CW and SSB. A 505 in good shape sitting on a table in a flea market can fetch from $125 to $200.

By far the most popular of the Argonauts is the 509. Several fixes from the 505, the 509 is still on the air today. Plan on shelling out between $175 and $300 for one.

The last of the Argonauts, the 515 is a rare find today. Plan on spending $300 to $450 for a 515 in mint condition.

OK, I lied. The last of the last of the Argonauts, the Argonaut II, is very rare. Plan on spending about $800 for one. If you see a Delta II, that's the same thing as the Argonaut II, with a 100-watt PA stuck on the rear end.

With the exception of the Argonaut II, there was a handful of accessories for the Argonaut family. The most common accessories were the audio filter and crystal calibrator. There was also a small antenna tuner as well. If these are included in the sale, take note, as they are very hard to come by. You won't see them sitting all by themselves in the flea market.

The 405 amplifier shows up every now and then. Expect to spend about $150 to $225 for the unit. The high end I just quoted is more than the amplifier sold for, new. There was also a power supply that was required to power the 405 amplifier. If the supply is included with the amplifier, adjust your pricing accordingly.

Although not exactly in the QRP class, the Ten-Tec Century 21 and Century 22 are used by many QRP operators.

The original Century 21 with the analog dial should go for $125 to $175. The digital version of the Century 21 will fetch $150 to $175. The power supply is internal to the Century 21. There were two options: the audio filter and the crystal calibrator.

The Century 22 is a rather rare find at a hamfest. Sporting an Argosy-like appearance, the Century 22 will set you back about $250 to $325. A calibrator and keyer were options. The Century 22 did not have an internal power supply.

Completing our list of Ten-Tec equipment are the Argosy I and Argosy II. The Argosy is one rig that I have kept through all these years. It's the one they will have to pry from my cold dead fingers when I kick off. An Argosy I in good condition will go from $250 to $325. Plan on spending from $325 to $400 on an Argosy II.

There was a slew of options available for both rigs. These options ranged from a crystal calibrator to a noise blanker. There were optional crystal filters along with an audio filter, too. The power supply was also an option. If you plan on running an Argosy portable with battery power, you will need the magnetic circuit breaker. I've been told that Ten-Tec no longer carries this breaker. When dickering over the price of any of the Argosy rigs, keep in mind the options (or lack thereof) offered in the deal. Those crystal filters alone went for over $50 each!

Odds and ends

There are two more rigs you may be looking for—the MFJ QRP series and the Yaesu FT-7. The MFJ rigs have been out there long enough that some are starting to show up on the used market. Although monoband, they're a lot of fun to use. Right offhand, about $80 to $100 is the going rate for one. Again, depending on whether the optional keyer and/or the audio filter is included. At Dayton, with a zillion dealers selling MFJ equipment you should be able to find a *new* MFJ QRP rig for $125.

Yaesu made a mobile QRP rig called the FT-7. Although a bit high-powered for a dyed-in-the-wool QRPer, they are popular. Designed mainly for mobile use, the analog dial is kinda hard to see. The FT-7 works both SSB and CW. An FT-7 will go for about $225 to $300. A bit more money ($275 to $400) buys you an FT-7A.

Well, that's my QRPer's wish list price guide for the Dayton hamvention. The flea market covers acres—wear your best old shoes and have fun. Stop by flea market spots 509, 510 and 511 for the finest in solar equipment or to just say hello! 73

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The Digital Port

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Serial modems and software just get easier and less expensive as some good-hearted hams contribute. You readers keep me hopping with word of products and procedures that make the world of digital hamming more fun all the time. I appreciate that. I counted at least seven individuals and organizations who are making a difference to the benefit of ham radio as I was writing this piece. Keep it up.

I goof now and then ...

Along the way, I also receive E-mail and letters about some of my goofs. One of the recent errors I must admit to was typing the incorrect URL for Terry Mayhan's Web site, *K7SZL's Unofficial HamComm Home Page*, where you can find all you need to know to construct your own HF serial modem. I left out one letter, and sure enough, alert readers let me know about it, quickly.

What did I learn? Not just to be more careful; I was being as careful as my squinty little eyes would allow. I developed a better technique and I will pass it along. I use Netscape software and when I bring up a Web site now, I click on the displayed URL which "selects" it, then press Control+C to copy the URL to the clipboard. This is what happens when I did that with the above-mentioned Web site and then pasted [http://www.accessone.com/~tmayhan/index.htm]. I am sure some of you alert readers have already discovered this, but I have only been doing it religiously since the incident I referred to. It also works well as I refer to Web sites in E-mail. That way I am sure a current working address is going to the recipient.

Sometimes, it just takes patience

Frequently, I get requests for the correct URL for PCFlexNet. There is no error in the address as reported here. The problems usually stem from the fact that something goes awry in the European Internet system. I have experienced this as well as have others I talk to. As long as the address is entered properly, the solution is to wait several hours or a day and try again. Magic things happen. Refer to **Table 1** for URLs.

There were several more things I learned when I received a request from Dave WA4GVT. Dave asked for assistance to get the information on the HF serial modem described in the above K7SZL's Web page as he did not have Web access.

New stuff

That was not too difficult. I brought up the Web page to make a fresh copy because I had scribbled on mine, and was glad I did. It seems Terry is enhancing his modem and the improvements are well defined in his displayed circuit and accompanying text. So, that is another project to follow up on if I am truly making the effort to keep abreast. I also downloaded, per request, appropriate shareware and sent it along to Dave.

Surprise in the mail

This didn't seem like a terrible burden, but there was another lesson to be learned. A few weeks ago, I received a package from Dave with a kit from LDG Electronics to build a 1200b packet modem as described in *73*'s February 1996 issue. The lesson? Hams don't let good turns go unnoticed.

At this writing, I have assembled the kit, but have not quite got it debugged. It copies the received signals and transmits, but the transmitted signal isn't correct. I contacted Dwayne at LDG and he sent additional info that should help get this modem going in the right direction. This will make a nice little board that I can combine into a box with my HF modem for portability. (Hams always have a dream, and their wives never know why.)

If the wife were looking over my shoulder just now and could see that there is also a perfectly good working model of the original BayCom 1200b modem in the shack, she would sagely advise that I "let well enough alone." This is good advice, but a digitally-challenged ham (interpret as you will) must be ready to try each new idea as it comes.

The BayCom modem arrived as a result of my quest for parts to build a replica of this little wonder. I checked with various suppliers and was not faring well with the TCM3105 chip. I asked George SV2AGW if he would check with his friends, as I knew they were deeply involved with modems. He advised me of some alternative chips but they did not appear readily available, so what did George do?

Rescued

He located a working BayCom modem and made it possible for me to obtain it for the shack. This is not to say there is some endless supply of modems stockpiled on a Greek island. That may have been the only one. This now gives me a standard by which to judge other modems and software. I must sincerely express my appreciation for the kind efforts of George.

Source For:	Web Address (URL):
HF serial modem plans + software	http://www.accessone.com/~tmayhan/index.htm
PCFlexNet communications free programs	http://dl0td.afthd.th-darmstadt.de/~flexnet/index.html
Tom Sailer's info on PCFlexNet	http://www.ife.ee.ethz.ch/~sailer/pcf/
SV2AGW free Win95 programs	http://www.forthnet.gr/sv2agw/
BayCom — German site	http://www.baycom.de/
VHF packet serial modem kit	http://www.ldgelectronics.com

Table 1. *Current Web addresses as of this writing as mentioned in the text. There are more and I will add to this group and post it frequently. All of the above were cut-and-pasted directly from the Web page to avoid the inevitable errors when copying. If you encounter a problem with a European address, the network is often at fault. Try again later.*

The first thing I had to do to put the BayCom into service was make a cable to my ICOM 2AT radio. The information with the modem showed there was no PTT line. This seemed a little strange so I took a look at the BayCom Web pages and found the radio jack described for the display model on the Web site was different and included a PTT line.

Just plug it in

After a little thought, it seemed logical that if there was no PTT line, then a keying circuit must be included in the hardware as it came. George had said something about advising me if I needed a PTT. Anyway, I made up a cable with just the three lines available, transmit, receive and ground, hooked it up and it played beautifully.

The first software I used was the BayCom DOS software because I knew it always worked. It is a good package once you cause your mind to follow the proper patterns. I think it will do about anything I could ask, but I wanted to try something that had not worked with my previous go-round with a packet serial modem.

I wanted to see this modem work with a Windows 95™ program. What better than to test the "new and improved" SV2AGW Packet Engine and accompanying Terminal program. I went to the Web site, [http://www.forthnet.gr/sv2agw/], and downloaded the files dated Jan. 28, 1998. I understand new revisions are shortly forthcoming and will be available before this is published.

The updated programs really perform. There is not a lot of configuring because the software does it all, and since there is no TNC with built-in parameters to change, you only need a few minutes to be sure the software is looking out the proper serial port and you have your call inserted. (Packet just won't connect, regardless of the system you use, unless your call is in the software or, in the case of a TNC, in the hardware memory.)

Incidentally, George claims I could run my PK232 or other TNC at the same time as the serial modem with his software. It is not only flexible to drive other than a serial modem but can be open to 100 simultaneous connections. Very versatile.

While I was checking the parameters one of the screens started displaying the activity on the monitor. Looking good! I pulled down menus until I found the one with "connect" in it and clicked on it. I entered the local call, "CCBBS," clicked the box to connect, and it did the job. Best ever with a serial modem and Windows 95 combo! See **Fig. 1**.

And it's all free!

George really did a great job and he admits he has more to add. He is an example of hams going the extra mile. George writes these programs, puts them on his Web site and leaves them there as freeware. That is a lot of work in anybody's books to just give away and expect nothing in return.

I did notice one problem that George admits he must repair. Somewhere, during his updates, the ability to print went away. It is a small problem. I found I could work around it by saving the contents of the screen to a file and then opening it with the word processor. From there it was a snap to print. Most of us have little reason to print packet messages but we do it once in a while and there is a way even though this Windows program has lost that function for a time.

I gave a wrong description

During communications with George, he informed me that I had described one of his other programs incorrectly. Another goof. On his Web site, he has a program, AGWBBS that I did not previously download and assumed it was a program to

Continued on page 62

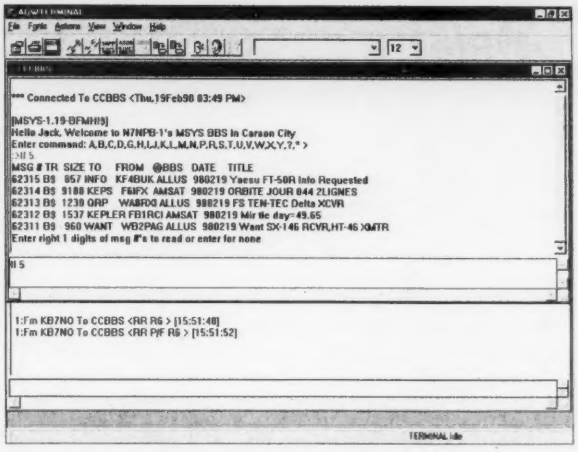
*** Connected To CCBBS <Thu,19Feb98 03:49 PM>
[MSYS-1.19-BFMHR$]
Hello Jack, Welcome to N7NPB-1's MSYS BBS in Carson City
Enter command: A,B,C,D,G,H,I,J,K,L,M,N,P,R,S,T,U,V,W,X,Y,?,* >
MSG # TR SIZE TO FROM @BBS DATE TITLE
62315 B$ 857 INFO KF4BUK ALLUS 980219 Yaesu FT-50R Info Requested
62314 B$ 9186 KEPS F6IFX AMSAT 980219 ORBITE JOUR 044 2LIGNES
62313 B$ 1230 QRP WA8ROQ ALLUS 980219 FS TEN-TEC Delta XCVR
62312 B$ 1537 KEPLER FB1RCI AMSAT 980219 Mir tle day=49.65
62311 B$ 960 WANT WB2PAG ALLUS 980219 Want SX-146 RCVR,HT-46 XMTR
Enter right 1 digits of msg #'s to read or enter for none
1:Fm KB7NO To CCBBS <RR R6 > [15:51:48]
1:Fm KB7NO To CCBBS <RR P/F R6 > [15:51:52]

Fig. 1. The latest SV2AGW terminal program in action on the laptop using the BayCom modem. The upper screen displays the information from the local PBBS that we want to read. The lower screen shows the background activity that takes place between my station and the bulletin board. It is not necessary to display this screen, but it is available for you to check when the connection seems to be going awry. You manage this from the Windows™ menu.

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Moderator's note: Roger and Ron Block of PolyPhaser Corporation have put together a well-written series of tips and suggestions on how we can protect our ham radio stations from the effects of a lightning strike. So far in this series (which began with the January 1998 issue), they have covered some interesting lightning statistics; antenna location; the importance of a single-point ground system and how to install an effective underground radial system to disperse the energy in a strike safely; what shape and size ground conductors are best to use; soil doping; ground resistance measurement; how to handle dissimilar metals; how to minimize pickup of radiated energy from a lighting strike; how to protect your coax and rotor control cabling; and some tips on protecting utility lines entering and exiting your ham shack (and home). Part 4 of the series was presented last month; part 5 now follows.

Lightning protection—what your mother never told you!—Part 5

When dealing with grounding systems for lightning protection, be sure to route all ground straps and grounding conductors to form a gentle bending radius. Bends sharper than a one-inch radius will add unwanted inductance to the desired ground path. Sharp bends should not be used even for conductors that are buried underground.

Coaxial protectors should have DC blocking on the center pin, i.e., they should show an "open" to DC current (such as when measured with a typical ohmmeter). This serves as a form of high-pass filtering, which prevents the DC, and the low-frequency energy of lightning, from continuing on toward the equipment. The strike energy is diverted into the ground system instead, in a controlled, predetermined fashion. This DC blocking also ensures the operation of the protector regardless of the input circuitry of the equipment being protected. Since lightning is mostly of the same polarity, protectors (or even RF equipment with ferrite core material inductors to ground) will carry enough surge current from a strike to saturate those cores. Over time, the ferrite material will therefore become "oriented" and will no longer be random. This is the primary reason why isolators often have less directivity over time, and become lossy. Protectors using ferrite coils prior to voltage crowbar gas tubes will also experience a VSWR degradation with repeated hits.

Protectors with DC continuity will not work on receivers and shunt-fed duplexers. The shunt-to-ground inside a receiver (the input coil to ground for static draining) prevents the low-frequency lightning from being conducted safely to ground by a protector having DC continuity. Here's what happens: The coil in the receiver shunts the energy to ground, but at the wrong place. If the coil cannot handle the energy (half the coax surge energy is on the center pin), the coil will open, and the current will translate to a large open voltage source capable of arcing anywhere within the radio. The best protectors DC-block both the center pin energy, and the shield energy, from the equipment, thus preventing shield energy from continuing to the equipment chassis. If the "withstand" voltage (shield protector turn-on level) is exceeded during a strike

THE DIGITAL PORT

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operate a packet BBS. I stated that as a fact a few months back.

The program is really an automated access program to access your local PBBS, list bulletin headers as you classify, plus automatically retrieve your mail and send your outgoing mail. I downloaded the program, installed it, and it works. I didn't spend a lot of time with it because my local packet activity is really limited compared to folks in the big city.

Previously I have mentioned that I am located in a valley that severely limits access to line-of-sight radios such as those used for packet. Even though the city is getting bigger, that one aspect never changes. Until they level the hills around here, there is a certain peaceful isolation that remains.

Remains from when? Thirty-five years ago, you could wake up to the sounds of cows in the nearby pasture. Actually, even today there is still a half-mile marked off as open range inside what is now a residential area. That means if you run down a stray cow on the street, you pay the owner the value of the cow. It had the right of way and you were trespassing. Seems strange in a town that has grown from 5,000 to 50,000 inhabitants in 40 years.

That population explosion is, of course, referred to as *progress*—the boon for developers and the bane for the erector of antennas. Carson City now has ordinances just like the big cities. Fortunately, I have had antennas in place for a number of years.

This little aside wasn't meant to wander far. I was merely setting the stage for the fact that it is difficult for me to comprehend the intensity of packet usage where traffic is going and coming from a packet BBS all day long and how frequent access would yield continuous cutting-edge information.

That is what the AGWBBS program can afford for the many of you who are located next to highly active ham PBBSs. What is different here is that the local PBBS uploads and downloads its changed content from a parent PBBS around the mountain once a day and that is the activity. The rest of the time we can dodge the cows on the city streets.

SSTV program for serial modem

Another bit of education came in the mail a week or so ago and I have only had time to give it a cursory inspection. John WB2OSZ sent me a copy of *Pasokon™ TV Lite* to work SSTV with a serial modem. I loaded it into the laptop and it is a beautiful program. The complexity must equal that of a Windows program, judging by the functions available and the time it took to install itself.

There is an annoying problem with the IBM ThinkPad™. They do not have the mouse working in DOS and this DOS program really must have a mouse to make it perform. I will either get a DOS mouse driver into the laptop or load the program into the desktop and let you know how it works next month.

If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line at [KB7NO@N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO. 73

event, and if a proper single point grounding system is in place, the voltage on the shield to the equipment will not exceed 10 kV.

Ham shack location and protection

A basement is an ideal location for a ham shack. It's close to ground and generally has the lowest inductance run to the exterior grounding system. Because it's below grade, magnetic shielding may also occur naturally. Most basements, however, have concrete floors, and since concrete is considered a conductor, the equipment must not sit directly on the concrete floor. In the event of a strike, surge energy could enter the shack and seek out a ground path through the equipment and to the floor. Insulate the equipment with a material that does not absorb water (a material that won't become hydroscopic from water or even moisture in the air). Polypropylene is a good choice for a full-footprint sheet insulator.

The first floor of a building is the next best location for your ham shack location. Just remember that magnetic shielding may be less, and the inductance to the ground system may be higher (due to a longer ground strap run). If the tower is located very close to the building, the recommended grounding strap (running from the exit point and down the building's outside) may itself inductively pick up some energy from the tower. This is also true for the coaxial cables, cabling for any tower lights and rotor lines. The longer the parallel run with respect to the tower, the more energy will be coupled. Protect these lines at the tower base with an EMT steel conduit. The conduit should be grounded to the equipment ground end only, and will act as a Faraday shield for the cables inside it. If the tower is somewhat farther from the building, it will be necessary to provide protection at the tower, for all lines, as well as have protection inside the shack itself. In this case, ground the conduit to the tower end only. Do not run any unprotected lines in the EMT. Protectors must be grounded to each other and to the tower ground. Place the protectors inside a weatherized NEMA (National Electrical Manufacturers Association) approved box, such as a NEMA 3R or NEMA 4X. Make sure the weatherized box and inside mounting plate are properly grounded (removing the paint from the box's outside and inside surfaces at the ground point) and use the correct joint compounds to weatherize all connections. Stainless steel hardware is also an option. All connection lugs must be crimped, soldered and weatherized. Remember, standard 60/40 solder will not hold up without protection when exposed to sunlight and ozone. If possible, try to use 96% tin and 4% silver solder; it has more strength and will handle high-surge currents, because it's specifically a high-temperature formulation. Use a short section of strap or a husky pigtail to bond between the inside surface of the NEMA box and the inside protector mounting panel. Ground any conduits at the ground level. Again, use the proper joint compound prior to either a vertical run or an entry into the building. Good mechanical and electrical connections don't just happen—they're based on experience and planning.

Roger and Ron Block's series will return again next month with more of what Mom never told you on how you can best protect yourself, and your station, from the destructive effects of lightning. This ongoing series in the "Ham To Ham" column this year is "must" reading for everyone who spends any time stretching conductors in the sky (and in the ground) in pursuit of that elusive rare one.

A "T" for top band

From Tom Hart AD1B: "One of the more popular wire antennas for the HF bands has been the venerable G5RV dipole, a classic antenna that operates well from 80 through 10 meters in its normal configuration. I've been using the G5RV myself for a number of years, all the way up to six meters, and have logged nearly 2,000 contacts with it on the RS-12 satellite to boot!

"On 160 meters, however, the G5RV (being horizontal) generally produces rather poor results, since most of us can't get a dipole style of antenna up in the air nearly high enough to obtain a good horizontal launch angle at 160 meters—most of the signal ends up going straight up! Even at 40 feet up, a horizontal dipole at top band (160 m) is only .08 wavelength above the ground, which would be functionally equivalent to putting your 10-meter dipole just three feet off the ground! Successful 160-meter operation, therefore, generally involves using a vertically polarized antenna, but unless it uses a large and lossy loading coil, it too will be extraordinarily tall—150 feet or better!

"Wanting to operate some 160-meter contests and other occasional get-togethers, I decided to try some simple (and easily removable) modifications to my own G5RV ... and a top-loaded 'T' configuration is what I found the easiest to implement. Additionally, it does a reasonably

Continued on page 70

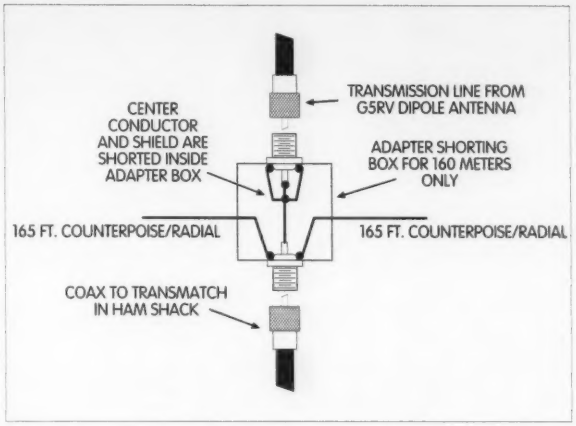
TRANSMISSION LINE FROM G5RV DIPOLE ANTENNA
CENTER CONDUCTOR AND SHIELD ARE SHORTED INSIDE ADAPTER BOX
ADAPTER SHORTING BOX FOR 160 METERS ONLY
165 FT. COUNTERPOISE/RADIAL
165 FT. COUNTERPOISE/RADIAL
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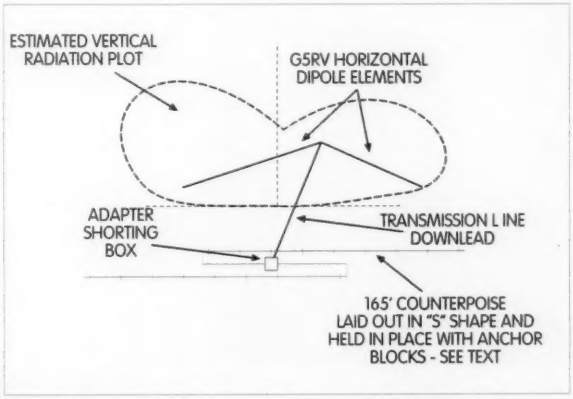
Fig. 1. Details of the adapter shorting box and counterpoise/radial hookup used at the base of AD1B's G5RV dipole antenna to permit him to temporarily utilize the antenna on 160 meters as a top-loaded vertical.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ADAPTER SHORTING BOX
TRANSMISSION L INE DOWNLEAD
165' COUNTERPOISE LAID OUT IN "S" SHAPE AND HELD IN PLACE WITH ANCHOR BLOCKS - SEE TEXT

Fig. 2. AD1B's modification to the popular G5RV HF dipole antenna to permit contest weekend operation on 160 meters.

Home-brewing, Italian Style!

A two-element phased beam for ARDF.

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84129 Salerno
Italy
Packet:
[IK8VWA@IK8SUT.ICAM.ITA.EU]
E-mail: [ik8vwa@hotmail.com]

I'd like to share with you the antenna I built to take part in the "Town of Salerno, Italy" ARDF challenge, my first experience in this kind of amateur radio activity. Thanks to my homemade beam, I've reached the fourth absolute place, 26 seconds after third (not bad, eh?). Believe it or not, the total cost was about six dollars (US).

Photo A. *The author, ready for the RDF challenge: handie-talkie in one hand, two-element phased beam antenna in the other.*

Assembly

First, cut five 50-cm sections from the PVC tube. Take two sections and insert them into the PVC "T" connector to form the support for the wire element. Either cement the connections, or just secure them with nut-and-bolt sets when you attach the coax to the elements. If you use the latter method the beam will be able to be "broken down" to smaller pieces for storage. Construct the second support in the same manner as the first. Now, take the last 50-cm piece of PVC and use it as the boom to connect the two vertical sections. Use lock screws at each connection to keep the vertical sections properly aligned.

At this point the beam is physically ready, so let's assemble the electrical part. Cut four pieces of insulated copper wire, each 49 cm long, and solder ring terminals to one end of each piece of wire. Depending on the wire used, it may help to gently file the end of the wire, to allow the solder to make better contact, and so the wire will fit properly in the terminal.

Cut a 102-cm piece of 50Ω RG-58 coaxial cable for use as a delay line (3/4 wavelength, multiplied by 0.66, which is the velocity factor of the cable used). Solder another set of ring terminals to the coax. Now put the

Parts List

Quantity	Description
5	50-cm sections of 16 mm PVC tubing
2	PVC tees to fit tubing
6	nut-and-bolt sets
2	lock screws
4	49-cm sections of 1.5 mm insulated copper wire
8	ring terminals
102 cm	50Ω RG58 coaxial cable
	solder
	cement (optional)

Table 1. *Parts list for the two-element phased beam.*

electrical wire pieces (the ones you cut before) on the elements, securing them with black electrical tape. Leave some space between them so it's easier to make the coax connections. Connect the delay line between the two elements. This is a phased beam, with electrical delay of 270 degrees between elements, so make sure the connections to the delay line are not crossed. These connections can be made with short nut-and-bolt sets, or can be attached to the longer screws holding the PVC together (if you didn't use cement on the vertical sections). Finally, connect the section of cable that connects the handie-talkie and the delay line.

The antenna is ready, and you'll have assembled an inexpensive, light, flexible, portable, competitive beam. You'll be happy with your new antenna, and I'll be happy because I have been able to share the "Ham Spirit" with you.

Any questions? Please feel free to contact me at the address at the beginning of this article. 73

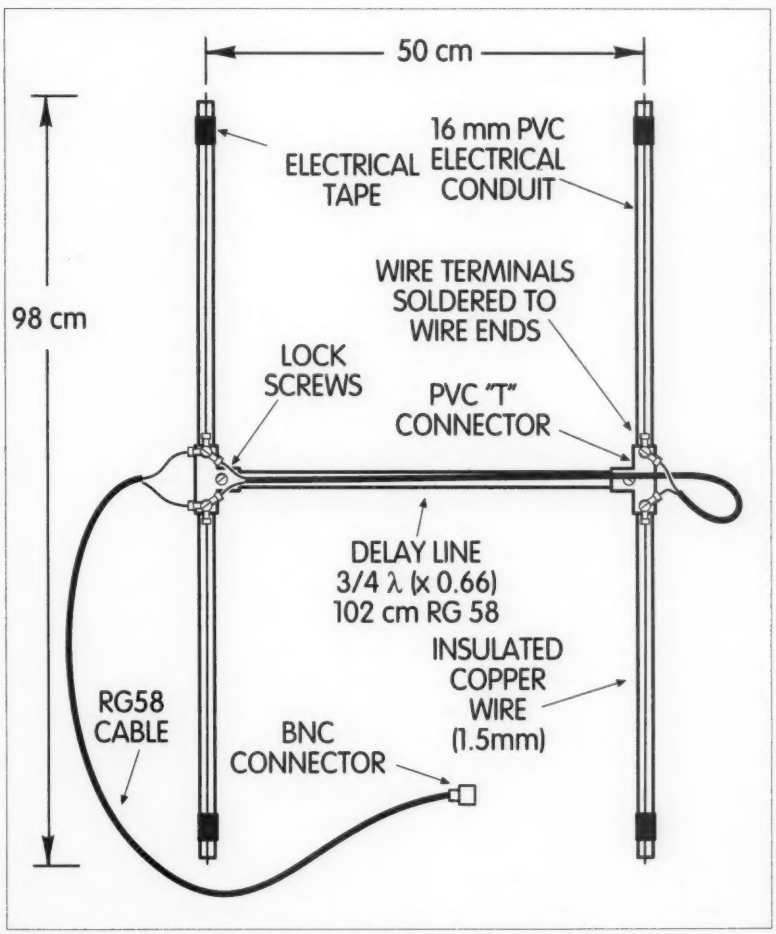

Fig. 1. Two-element phased beam for ARDF. Caution: Keep the feedline parallel to the delay line by mounting it along the boom.

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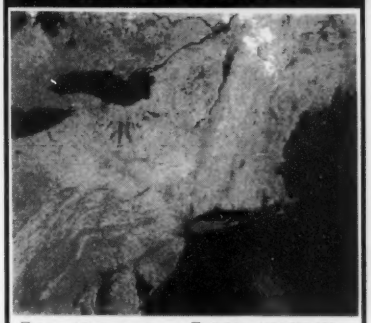

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Have you ever looked at a new rig, or even a picture of a new rig, so long and hard that you almost drooled on it? That's the way I saw the ICOM IC-706. What a great idea for a rig—a complete design; the everything transceiver. I had been using my trusty Kenwood TS-130S, which I loved, for many years. It was everything I had needed ... however ...

I used the 130 as my secondary rig at home and while camping, and sometimes ran it mobile—and it had served me well. However, that little 706 *did* have a general coverage receiver, and it *did* cover six meters, and it *did* include two meters, and it *was* all mode, and it was *so* small, and ...

I counted the money in my "squirrel fund," and collected all the loose change in the sofa cushions, plus I looked in all the nooks and several crannies to gather enough money to buy me a 706. After all, it had been more than 15 years since I had bought a new low-band rig. By the time I was actually ready to make my purchase, the IC-706 Mark II had come out and it even looked better than the original 706. I just had to have one.

I sold my TS-130S, but did not immediately jump in and call around to dealers to find the best deal on a 706 Mark II. I was anxious. I wanted to make this purchase perfect. I would take some time and check all the angles, and give every dealer I could find a chance to be my provider.

What I came to call "The Great Experiment" is the process I used to find the best deal for purchasing ham equipment, though it is, of course, equally applicable to any multi-item purchase—especially by an organization or club. The final prices can and will change. You should already be aware that any dealer's quote can change according to many factors, including the number of units in stock, proximity to the due date of a large invoice, how hard the supplier is pushing that dealer to "move more of those units," as well as other reasons.

I was interested in the ICOM IC-706 Mark II, and some of the accessories for the transceiver, including filters, voice synthesizers, and mounting brackets. I also wanted to include a couple of accessories for my ICOM IC-2340 dualbander. The request for quote was for a total of nine items, including the free separation cable being offered for the transceiver.

In early November, I contacted several dealers to get an idea of the going general discounts and prices. From my initial requests, some dealers quoted a good price on the transceiver, but some prices weren't so attractive for the accessories; some bids for the accessories were good, but not so good on the transceiver. However, I now knew the prices at which dealers were willing to sell the various items. I took the lowest price of the transceiver quotes and the lowest prices on the accessories quotes and put together a combination of the two. I added $20 for shipping and came up with my target figure.

My next step was to make up a list of ham dealers around the country, using advertisements in *QST*, *CQ*, *Amateur Radio Trader*, and *73*. I got some from the Internet sites of various ham home pages and some came from the ICOM home page which listed their dealers (a few companies did not advertise any connection with ICOM equipment so I didn't include them). If any dealers of ICOM products are not included in this list, I apologize—however, it may reflect their failure to advertise in the best-known ham magazines.

Here I must stop and provide one extra piece of information about myself.

From 1970 to 1981, I owned Derrick Electronics, a ham radio store in Broken Arrow, Oklahoma. I realize, perhaps better than most hams, what's involved in a ham radio dealership—it is neither the easiest nor the most lucrative business to operate. Most ham store owners are in business because they love the hobby and they want to help their fellow hams. Somewhere in that process, they hope they are able to make enough to feed their families and operate some really nice equipment at their QTH (sometimes in that order). The markup on ham equipment is much less than on many other items which are sold through retail stores. Ham equipment certainly does not allow the profit margins common for items such as appliances, clothing, and furniture. When you see advertisements in the newspaper for sale prices offering as much as "50% off," you know the markup has been enough to allow these deep discounts and still allow the merchant to glean at least a small profit from the sale. Ham equipment dealers are not allowed these high markups. Their profit margin is slim.

From experience, I had an idea what the dealers were paying for the merchandise I was requesting—but I had no intention of trying to get the items at cost. The dealer needs to make a profit to stay in business. I did know, however, the minimum prices being offered by various dealers. I just wanted to gather all of those prices together under one dealer's offer.

I created a letter detailing the items I wanted to purchase and the fact that I was searching for a dealer who could provide me a good price on both the transceiver and the accessories. The letter was sent out to all of the dealers on the list. I let them know that all the letters left my post office on the same day, so they knew they were playing on a level playing field.

The letter gave all the dealers two weeks, which I thought would be a sufficient amount of time to respond, before I would make my decision. I offered to pay by check, credit card, or certified check, because I realize that the dealer who accepts plastic must pay extra for using that privilege. I also suggested that if a dealer thought he had a particular reason why I should buy from him, because of something extra he offered, to let me know. Return quotes could be made via E-mail or snail mail and I listed addresses for both.

One dealer offered me additional information, including the telephone number of the service department, on how I could call ICOM directly to get the service manual, and I appreciated that. Actually, when I called ICOM, their price was considerably higher than many of the dealers had quoted for the manual. I suspect that many service manuals do not have a posted retail price, and a dealer is free to price them according to what the traffic will bear.

When the responses began to arrive, I placed a number and date on each and entered the information into a spreadsheet (**Fig. 1**). The spreadsheet also listed the name of the quoter and their E-mail address, if provided. I noted on the spreadsheet whether an item was quoted as back-ordered, used, or discontinued and/or unavailable from that dealer.

Most quotes showed a breakdown on an item-by-item basis. However, a few

Dealer	IC-706 MKII Xcvr	FL-223 Filter	MB-62 Bracket	MB-63 Bracket	UT-86 Tone Squelch	UT-102 Synthesizer	UT-55 DTMF Decoder	UT-66 Synthesizer	Shipping	TOTAL
1	1249.00	79.00	20.00	14.00	63.00	55.00	49.00	59.00	14.55	1602.55
2	1270.00	70.00	17.00	12.00	46.00	50.00	50.00	55.00	20.00	1590.00
3	1269.95	99.95	25.95	18.95	69.95	74.95	69.95	83.95		1713.60
4	1279.95	79.95	22.95	16.95	64.95	64.95	59.95	n/a		1589.65
5	1269.95	99.95	25.95	18.95	69.95	74.95	69.95	83.95		1713.60
6	1279.95	69.95[1]	16.95	11.95	45.95	48.95	45.95	54.95	20.00	1594.60
7	1299.00	80.00	25.00	18.00	69.00	60.00	56.00[2]	60.00		1640.00
8	1149.95	82.95	19.95	13.95	54.95	58.95	54.95[3]	63.95		1499.60
9	1279.95[1]	84.95	25.00	18.00	69.00	74.00	69.00[1]	74.70[1]	20.00	1714.60
10	1249.00	70.25	17.05	12.30	49.35	49.35	Discont.	Discont.		1482.30[4]
11	1245.00	67.50	20.00	14.00	60.00	49.00	45.00	53.50	32.50	1586.50
12	1189.95	75.00	22.00	15.00	55.50	55.50	65.00[5]	65.00[5]		1592.95[6]
13	yes	yes	yes	yes	yes	yes	yes	yes	yes	1589.00[7]
14	1239.95	89.95	20.00	14.95	64.95	64.95	n/a	n/a	29.00	1523.75[8]
List Price	**1599.00**	**105.00**	**25.95**	**18.95**	**69.00**	**74.00**	**69.95**	**83.95**		**2045.80**

All prices in dollars. Key: [1]Back-ordered. [2]Used. [3]1-2 weeks. [4]Not all items, service manual $35. [5]Special order. [6]Service manual $50. [7]Including service manual. [8]Service manual in stock but no price quoted.

Fig. 1. *Sample spreadsheet.*

dealers offered a package price for all items. *Caution: Be sure that when a total price is listed, that all items requested are included.* Several of my quotes looked really good at first, but on closer examination I discovered an item or two had been omitted. I do not believe this was intentional and in a few cases the particular item was left off because that item was no long available to the dealer. A couple of dealers included the cost of the service manual as a part of the whole, rather than pricing it separately, as I suggested. This skewed the total so I entered a notation to that effect on the spreadsheet. Just be sure, when you are comparing final prices, that *all* items requested are listed. Numbers 4, 10, and 14 on the spreadsheet were examples of how the quote was incomplete. Number 7 was quoting one accessory item as "used" but did make a note of it. Their price on that used item was higher than the "new" price from another company.

It was interesting to note that some quotes, whether by E-mail or by regular mail, made a good first impression … and some did not. Some were carefully and neatly submitted on a "Quote Sheet" form, some on a computer-generated printout, some carefully typed, some in easy-to-read E-mail, but a couple were just hand-scribbled. I got the definite feeling from some that the quoter was saying to me, "Here … take it or leave it!" Others made me wish their proposal was better because I would like to do business with them—and probably will, in the future.

Even though I specifically placed a closing date in the letter sent to each dealer, and it gave them all nearly two weeks, I received one quote on the day after the closing date. That letter had been postmarked only two days prior. Quite a few dealers who received the letter made no attempt to provide a quote. Maybe they did not sell ICOM, maybe they did not have any of the requested items in stock, maybe they thought they could not match my target price, or maybe they were offended by my method of obtaining a quote, but I believe I did get a good representative sample of the 46 dealers queried.

Several companies have sites operating under the same name, located in different areas of the United States. I sent letters to all of the sites, even though they appeared to be parts of the same company. I discovered that some of these groups quote exactly the same prices for each piece, as though they accessed a central price data base. Other stores, sharing the same name, were organized more casually; it seemed as though they were simply linked together to allow quantity buying, and the stores were operated independently. I got quite a variation in prices from this group, although they were typically very competitive and interested in helping me find a good deal.

The quote I chose from dealer number 8 simply blew all the others away and had I not done "The Great Experiment," I might never have found that company—I hadn't previously bought from them. After tentatively deciding on that particular dealer's offer, I called them on the phone to make sure their quote was just as I had requested: "New equipment, in the box, no demo, with full warranty." The man on the phone was helpful and pleasant and gave me additional assurance that I had made the correct choice in dealers. Their quote had come via E-mail and listed the quoter's name, which I appreciated. The person who had provided my quote from this dealership was not there at the time I called, but the man I spoke with had no problem making the sale from the information I had received.

The dealer I chose had offered me two prices, either using a credit card or paying by money order, but told me a credit card would be quicker. My call to the dealer was on a Friday, and my new IC-706 Mark II, complete with accessories, arrived on the following Tuesday. A couple of accessories were back-ordered but the seller noted that they would pay for shipping when those items arrived.

I have deliberately chosen not to name the dealers who participated in this experiment. As previously noted, a dealer may offer an entirely different bid at dates separated by months or even weeks. I attempted to make my target price a fair figure, based upon sample proposals received prior to the beginning of the experiment, and also upon my experience as a ham dealer. I believe dealers should always have a chance to make a profit, or they cannot stay in business. As a matter of fact, of the 46 letters sent out, I got two back unclaimed, and I assume that it was because two of these dealers are no longer in business.

One note of interest came when the package arrived. My invoice showed that a coupon for $100 off had been used. I knew ICOM was offering a coupon for $100 off on the older IC-706s but I was unaware of any such deal on the Mark II. The dealer had used a $100 coupon to make my quote attractive enough that I would make my purchase from them—and I had the radio in hand. Several days later, while scanning ICOM's Web page, I discovered that, beginning on December 5, during the time that dealers were reading my letter and preparing their quotes, ICOM had started offering an instant $100-off coupon on the Mark II. All dealers I contacted had the same opportunity to use this coupon to make my quote better, but only one, to my knowledge, had used it. Maybe the other dealers were unaware of the promotion since it had just begun, but because my dealer had checked either the mail or the ICOM Web pages, it allowed them to offer me the best deal. Their attention to business made the difference.

A close look at the spreadsheet shows the wide variation between prices on the accessories quoted. For instance, the MB-62 mobile bracket, which lists for $25.95, drew variations in price from $16.95 to the full list price. Also, the UT-102 voice synthesizer for the 706, which listed at $74.00, brought quotes from $74.95 to $48.95. Perhaps the source from which I got the list prices had incorrectly shown this item at $74.00 when it was actually $74.95. I would hate to think a dealer quoted me a higher-than-list price. One reason for the extra-attractive prices on the UT-55 and UT-66 for the IC-2340 may be that they

were being closed out as an older product, although not all quotes would suggest that.

This experiment proved to me that it was worth the extra effort to shop around. Do the dealers like this? I believe they do—it probably gives them a better opportunity to compete against other dealers. Remember, the target figure must be realistic: The dealer *must* make a profit.

I'm grateful to all the dealers who participated in my "Great Experiment." My only suggestion to a dealer would be to look over the quote you're sending to a customer and ask yourself: Does it look like you really want to gain that person as a customer? Is it signed, or does it at least have an actual person's name listed, so your customer can call back and talk to the quote provider? If you have an E-mail address or a site URL, did you provide it? Look at the correspondence you send out to others—what is *your* impression of your company, judging by what your *customers* see? How do others see you?

Not all of the larger dealers have the best prices or service. Many smaller dealers are willing to make you a good deal and provide you with good service—and they deserve your business, but you have to give them a chance. Perhaps their not having toll-free numbers means they don't need to make quite as much profit from sales in order to pay their phone bills.

If your curiosity is just too great and you want to know who my actual provider was, drop me an E-mail at [jpk5lad@bigfoot.com]. You'll need to do your own "Great Experiment" to find out the identities of all the other dealers, both those who responded and those who did not.

By the way, I really do like my new IC-706 Mark II. Yes, it was all worth it. As an aside, as I was finishing up on this article, the UPS driver rang the doorbell and left me a postage-paid package with the three back-ordered items: the 706 Mark II Service Manual, the UT-55 DTMF encoder/decoder and the MB-63, which is the mounting bracket for the 706 control head. 73

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respectable job for a 'compromise' top band skyhook! What follows is what I've found to work nicely at my QTH and it should be adaptable to others.

"By the way, an earlier version of this idea was described in *CQ Magazine* some years back, but this latest configuration seems to give better results (at least subjectively) at a very small additional cost in terms of setup time and materials. Remember, this is a temporary, stow it-away-when-you're-not-using-it modification. The main addition is the Adapter Shorting Box shown in **Fig. 1**. It's nothing more than a way of connecting the shield and center conductors of the coaxial downlead from the G5RV dipole together—shorting them together, if you like. This turns the centerfed G5RV dipole into a top-loaded or 'T' type of vertical radiator. Next, two counterpoise wires (or radial wires), each 165 feet long, are added to the base (adapter box) connector that eventually connects to my transmatch (antenna matching unit) back in the shack. The two 165-foot counterpoise/radial wires are wound up onto a section of cardboard tubing, and unwound and laid out on the ground when I want to configure my G5RV for top band. Most of us can't unwind 165 feet of wire in a straight run, and neither can I, so the counterpoise/radial wires end up making something like a large 'S' shape on the ground—but the wire is still out there. To help keep the counterpoise/radial wires in place, I've made up several six-inch lengths of wooden two-by-four section 'anchors,' each with spring-action wooden clothespins glued and nailed to the two-by-fours. I place one of these 'anchors' at each bend in the counterpoise/radial run to keep the wire from being blown or kicked around while it's out and in place.

"That's basically it ... I've found that the G5RV, configured as I've described, and operated via a transmatch in my shack, will give me a usable bandwidth comparable to what I'm able to achieve with the 'stock' G5RV antenna on 80 meters—not bad! The estimated vertical radiation pattern is reasonable as well, and **Fig. 2** gives you an idea of what you might expect if you decide to duplicate the idea. Again, my original goal was to be able to operate on 160 meters, with a usable signal, primarily for contests and other short-duration work, without the need to erect a dedicated top band radiator. By using this technique, and the information shown in the *ARRL Antenna Handbook* and published by ON4UN, I ended up with a satisfying compromise antenna with very little effort or cash outlay. Give it a try at your own station."

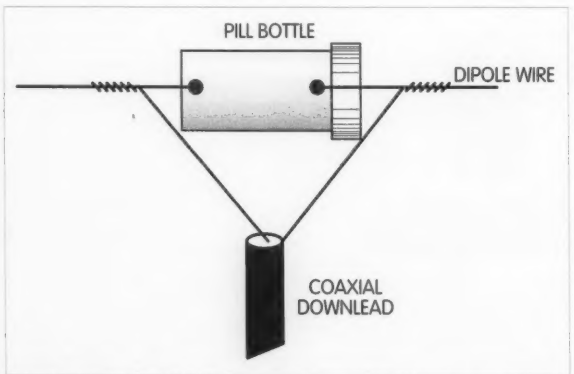

***Fig. 3.** Indoor wire dipole using a discarded pill bottle as the center insulator.*

Fuse tale

From Bob Boehm N8EXF: "After struggling to remove the tiny GMA-style fuse mounted on the printed circuit board of my Kenwood TS-50 after it opened, I decided to make my life a little bit easier the next time that fuse might give out. I cinched a small nylon cable tie around the new fuse's body, leaving enough 'tail' on the cable tie for me to easily grab it, before replacing the fuse in its clips. The cable tie's 'tail' will make the chore much easier, if and when the tiny fuse needs replacement in the future. Of course you can adapt the idea to any small cartridge-style fuse in any hard-to-reach location."

Not quite what the doctor ordered

From Harold Proppe Jr. K6QVD: "Now that I'm a senior citizen, I've discovered the 'advantage' (?) of having lots of empty plastic prescription pill bottles to dispose of! In addition to storing small parts, they have other uses in and around the ham shack. If you need a quick coil form or a lightweight dipole antenna insulator (**Fig. 3**), a pill bottle will often be just the ticket. They're also useful as small containers for holding tiny circuits (for interfacing one gadget to another) or perhaps enclosing a switch or jack for this and that purpose ... and because they come in many varied sizes, keeping a stock of them on hand will usually produce the one that's just right for the project in mind."

Moderator's note: It's easy to test a pill bottle's RF insulating qualities if there's any question of its propriety for use as a coil form or insulator as Harold suggested. Just place it in a microwave oven for 60 seconds or so, along with a small glass of water to act as a known load, and see if the pill bottle gets hot to the touch. If it doesn't, you know that it's RF transparent. Ultraviolet light can also disintegrate many plastics, so before using an unknown plastic as a permanent outdoor antenna insulator, set one outside, exposed to the sun for a while, and see how much it's affected. For indoor or attic antennas, UV susceptibility isn't a concern.

Murphy's Corollary: The farthest distance between two points is usually the shortcut.

Many thanks, as always, to this month's very much appreciated supporters, including:

Roger Block, President
PolyPhaser Corporation
2225 Park Place
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Thomas Hart AD1B
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Bob Boehm N8EXF
6821 Le Conte Avenue
Cincinnati OH 45230-2935

Harold L. Proppe Jr. K6QVD
1385 Skyline Drive
Laguna Beach CA 92651

If you're missing any past columns, chances are you'll be able to find them at *73*'s "Ham To Ham" column home page (with special thanks to Mark Bohnhoff WB9UOM), on the World Wide Web, at [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73 Magazine*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73 Magazine* for any equipment damage or malfunction resulting from information supplied in this column.

Please send any ideas you would like to see included in *73 Magazine*'s "Ham To Ham"

Continued on page 71

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

On Tuesday, January 6, 1998, the Houston AMSAT Net celebrated its 200th airing via geostationary commercial satellite. To mark the event, several guests were invited to take part via phone patch, including AMSAT President Bill Tynan W3XO, Executive Vice President Keith Baker KB1SF, Vice President for Manned Space Operations Frank Bauer KA3HDO, Vice President of Engineering Stan Wood WA4NFY, and Spacecraft Integration Manager Lou McFadin W5DID.

In addition to the satellite feed, the net was available via VHF and UHF FM repeaters in many parts of North America, local amateur television in Houston, live audio on the Internet, and later retransmission from WAØRCR on 160 meters.

Are radio nets dead?

The amateur satellite program and associated radio nets easily predate personal computers and the relative ease of global communication we now take for granted. Today we can quickly locate information about hamsats and related topics via the Internet. A great place to start is the AMSAT North America Web page at the URL (Universal Resource Locator) [http://www.amsat.org]. But when you get there, the message conveyed by the site is about radio and satellites, not computers, cool graphics, and digital desktop technology. The Internet and the World Wide Web are only a tool or a means to an end. Your line of communication to the Web is as tenuous as the twisted pair of phone lines or slender fiber optics that make the connection possible. As long as all the puzzle pieces work, it's wonderful. When your Internet service provider (ISP) goes down, or something else happens, it's a mess.

AMSAT and nets

For many years, the shortwave AMSAT nets were the primary source of up-to-the-minute hamsat information. **Table 1** (from [http://www.amsat.org]) shows the current international and regional AMSAT nets. The international nets were scheduled for Sunday afternoon for optimum propagation and universal acceptance. The weekday nets were scheduled for Tuesday evening, since Wednesday (UTC) used to be the official recharge or experimenter day for the hamsats of the 1970s. While the satellites took a day off, operators got together for the latest operating schedules and news. Those nets shown as inactive will be reinstated as the sunspot cycle improves.

During the early years, without global computer networking, the net control station (NCS) for the 20-meter international net would be tasked with collecting and distilling bulletins for transmission and discussion on Sunday afternoon. For the Tuesday night East Coast net, the responsible NCS would collect current satellite news and bulletins from the Sunday 20-meter net and other sources. During his net he would read the material, take check-ins and answer questions. The Mid-America NCS took notes from the East Coast net to add to his own information and observations. The process continued for the West Coast. While the system worked, some details were lost from Sunday through late Tuesday.

NET DESIGNATION	DAY	TIME	FREQUENCY (MHz)
AMSAT International	Sunday	1900 UTC	14.282
AMSAT International	Sunday	1900 UTC	21.280 (inactive)
AMSAT International	Sunday	2300 UTC	18.155 (inactive)
AMSAT-NA East Coast	Tuesday	2100 local	3.840
AMSAT-NA Mid-America	Tuesday	2100 local	3.840
AMSAT-NA West Coast	Tuesday	2000 local	3.840

Table 1. *International and regional HF AMSAT nets.*

Current nets rely heavily on the Internet-based AMSAT News Service (ANS). Various AMSAT volunteers over the years, including WA2LQQ, WDØHHU, WTØN, and now NNØDJ, have accepted the duty of putting together pertinent news items every week. AMSAT officers like W3XO and KB1SF have stepped in on occasion during times of illness or schedule conflicts to provide the service. You can subscribe to ANS bulletins by sending E-mail to [listserv@amsat.org]. Simply ask to subscribe to ANS in the body of the message. The system is not automated, so message format is not critical. Other subscription services include AMSAT-BB—a forum of hamsat-related discussions; KEPS—the latest Keplerian element sets for satellite tracking; and SAREX—a forum for the Shuttle Amateur Radio Experiment.

With an information-laden Web site and extensive news and data distribution services, why bother with AMSAT radio nets? The answer is simple. Radio is our hobby and radio nets can be a live, fully interactive method to not only relay information but also to discuss amateur-satellite topics directly with others, using radios.

Local AMSAT nets

While the shortwave AMSAT nets can be very informative, conditions on the low bands can be erratic. Various groups around the country have taken the initiative to sponsor local VHF and UHF AMSAT nets to get the word out. Some satellite operators have very limited low-band equipment or, due to no-code licenses, none at all. A listing of some current local nets is shown in **Table 2**. Check the list for a local net near you. A few groups even have Web sites advertising their nets and local projects. The Colorado AMSAT Net page can be found at URL [http://www.idcomm.com/personal/nØvse/]. The Southeast

Continued on page 74

HAM TO HAM

continued from page 70

column to Dave Miller NZ9E at the address at top. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73 Magazine*. 73

Number 72 on your Feedback card

New Products

Turn Your PC into a Scanner

Sony's got a new radio scanner, the ICF-SC1PC, that gives controlled access to the airwaves with the click of a mouse. Operation is easy—the searching options are right there in front of you, as icons on your computer screen. You can tailor searches and create custom files; a supplied CD-ROM lists more than 3,000,000 records of FCC-licensed radio frequencies in the US, including public safety, marine frequencies, aviation, and more.

Check at your electronics, hobby and specialty stores for the ICF-SC1PC; the package includes the scanner, CD-ROM, interface cable, and interface software, with a suggested retail price of $429.95. Questions? Call (800) 222-SONY (7669).

Tokyo Hi-Mound Available Again

Milestone Technologies announces that the Hi-Mound range of Morse keys, paddles, and bugs is back—though it was formerly priced out of the US market by the value of the Japanese yen, recent currency stabilization has made import possible again. The line includes a complete range of keying equipment, from the simple and inexpensive to the "work of art," all at prices comparable to or better than other products available in the US, and they're all available from Milestone Technologies, 3140 S. Peoria St., Unit K-156, Aurora CO 80014-3155. For more information, call (303) 752-3382 or visit the Web site at [http://www.mtechnologies.com].

Found In Space:

The Radio Amateur's Satellite Handbook, by Martin Davidoff K2UBC, from the ARRL, which avers that it is the most comprehensive book ever written on amateur radio satellites, and that it will become the new standard for hams who want to experience the thrill of contacting other stations via an orbiting spacecraft. We suspect they're right, because the author also wrote the League's previous satellite book, 1984's *The Satellite Experimenter's Handbook*, the preferred reference work for more than 10 years.

The 372-page *Satellite Handbook* covers all aspects of the amateur satellite program, including tracking, station equipment and antennas, operating tips and techniques, and much more. There's a history of all the amateur spacecraft beginning with *OSCAR I* in 1961, and details of software and Internet sites of interest to keep you up-to-date. To order, send $22 plus $5 for shipping and handling (to US addresses) to: ARRL, 225 Main Street, Newington CT 06111-1494; or call toll-free (888) 277-5289; or shop via the Internet at [http://www/arrl.org/].

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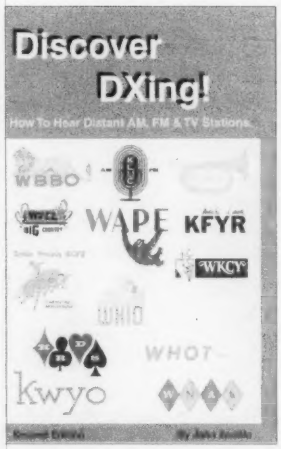

That's not just good advice. It's the title of a book by John Zondlo, published by Universal Radio, Inc. Here's your nontechnical introduction to hearing more AM, FM and TV stations. Topics include propagation, seasonal conditions, antennas and lots more on how to hear all 50 states on AM, all in an easy, conversational style. Get a copy of this 90-page second edition for $5.95 from Universal Radio, Inc., 6830 Americana Pkwy, Reynoldsburg OH 43068-4113. Call toll-free to order (800) 431-3939 (order #0019, ISBN 1-882123-45-X), or (614) 866-4267 for more information.

Better Late Than Never

Contact East's new 1998 General Catalog was available in January but with our lead time for announcements ... well, anyway, it's a terrific color catalog chock-full of anything you might need for testing, repairing, or assembling electronic equipment—and they offer same-day shipping: next-day delivery anywhere in the US! That's right—and there must be something in these nearly-300 pages that you can't live without. If you haven't already got your free copy, call (978) 682-2000; FAX (978) 688-7829; or request on-line at [www.contacteast.com].

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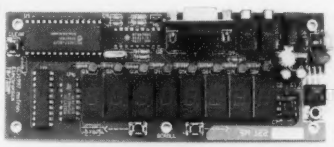

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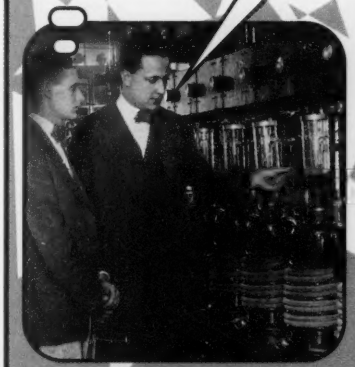

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Boston Area SPOT Net	Friday	2130	145.230
Central CA (Fresno)	Sunday	2000	146.940
Central NY	Monday	2000	146.880
Central OH	Sunday	2000	145.490
Colorado	Wednesday	2000	145.160, 145.460, 147.225, 224.980
Dallas/ Ft.Worth	Wednesday	1945	147.140
Derry NH	Friday	2000	146.850
Detroit MI	Tuesday	2000	145.330, 224.580, 442.800, 1282.050
Harrisburg PA	Sunday	2000	145.210
Houston TX Area	Tuesday	2000	147.100
Kansas	Sunday	2000	145.190
Long Island NY	Tuesday	2000	147.075
Portsmouth NH	Thursday	2000	146.805
Saco ME	Sunday	2000	146.775
SW Ohio	Tuesday	2000	145.110
Tucson AZ Area	Wednesday	1900	146.880
Waltham MA	Thursday	2030	146.640
Washington DC Area	Sunday	2100	146.835

Table 2. *Local VHF/UHF AMSAT nets.*

HAMSATS

continued from page 71

Michigan AMSAT Net page can be found at [http://www.wwnet.com/~jsmyth/intro.html]. The Houston Area AMSAT Net Web page is at [http://www.amsatnet.com]. Participation has been on the upswing in recent years.

The Houston connection

Prior to the attempted launch of Phase 3A in 1980, a group of hams in Houston used to get together on two meters to discuss their efforts to build antennas and equipment for the first high-orbit, long-life hamsat. No one had any experience with elliptical orbit calculations or the more stringent requirements of working stations through a satellite of this type, so the discussions became a net, a forum to exchange information. Phase 3A never made it into orbit due to a failure with the *Ariane 1* launch vehicle, but various Houston net participants kept meeting on Tuesday nights after the Mid-America 80-Meter Net to talk about satellite DX, radio equipment, and computers. During the last 18 years the net has thrived, continued with discussions and news dissemination, moved to repeaters, and tried some interesting experiments.

Photo A. *The author, W5ACM, handles net control and bulletins for the Houston AMSAT Net.*

In an effort to expand coverage of the Houston AMSAT Net, Craig Davidson WD5BDX, trustee of the Houston Net host repeater on 147.10 MHz, got permission to phone the net audio to a commercial, C-band, geostationary satellite uplink site that had some free audio-subcarrier time available. It was fun, merged in another high-tech communications medium to the net, and brought in listeners all over North America. In order to keep the operation on a low budget, it was necessary to change the day and time of the Houston Net to follow the availability of free satellite time.

Over the course of a few years, some stability was finally reached with the WØKIE Network in Oklahoma. Mike Reynolds' WØKIE offers inexpensive satellite uplink service to a number of groups involved with ham and shortwave listener (SWL) activities. For well over a year, the Houston AMSAT Net has been live on the Ku-band satellite SBS-6, transponder 13b, audio subcarrier 6.2 MHz. SBS-6 is located at 74 degrees west, just next to Galaxy 6. The time of the net has moved to 8 p.m. Central time, and is now on Tuesday nights, an hour before the regional, 80-meter, Mid-America AMSAT Net. The Houston group has had several net control stations over the years. With plenty of help from others, I have been the primary NCS for the past few (see **Photo A**).

A lot of hams have satellite-TV systems and, if they have Ku-band capability, can tune in the Houston Net with ease. For others, there are alternatives. Bruce Paige KK5DO had been experimenting with real-audio via the Internet in addition to his duties as the station in command of the uplink feed audio (see **Photo B**). The real-audio feed worked but was difficult to maintain and somewhat erratic. Another Houston ham, Greg Rice KB5OAT, came forward to provide the Internet connection through his Internet site at [greggo.com]. Linking to the live feed (or to check out the previous week's net) is done

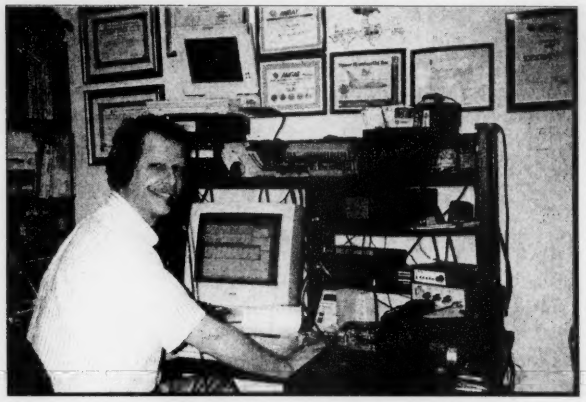

***Photo B.** Bruce Paige KK5DO is counted on for Internet check-ins, real-audio, and geosat audio control.*

through the Houston AMSAT Net Web page [www.amsatnet.com]. The real-audio feed has never been better and check-ins from around the world have been common.

A number of groups around North America have taken the initiative to capture the satellite or Internet feed and put it out over their local VHF and UHF repeaters. A list of these can be found at the Houston AMSAT Net Web page. George W1ME and Dana K4LK were a few of the first hams to connect regional VHF/UHF repeater networks, in New England and Florida respectively, to the Houston Net.

Vern Jackson WAØRCR in Missouri records the Tuesday net for later distribution on 160 meters. Every Saturday night at 9 p.m. Central, Vern carries the Tuesday audio on 1860 kHz AM. Although it's not "real-time," it has become popular with a growing number of hams in the central US.

Nets are supposed to be interactive, and the Houston AMSAT Net is no exception—it's just different. Houston hams can check in, ask questions, and make announcements through the local two-meter machine. They can also see the NCS on amateur television (ATV) through the Houston Amateur Television Society (HATS) repeater on 421.25 MHz. Those listening via the Internet or commercial satellite feed can use other methods to do the same. Bruce KK5DO monitors the Internet Relay Chat (IRC) site: irc, /server irc.chelmsford.com,6667, /channel #amsat. He can also receive E-mail during the net at [KK5DO@amsat.org]. Snapshots of the HATS ATV can be viewed on the Internet at [http://www.stevens.com/HATS]. The picture is updated every two minutes using "web-cam." Those who are not local and not on the Internet can call in via phone at (713) 467-9870. Marty Smith WD5DZC collects information for the net and takes the phone check-ins (see **Photo C**).

The availability of the Houston AMSAT Net via these many forms is dependent on the volunteers who take their time to make it happen, as well as the use of the commercial connections. From these experiments, the group hopes to find the best and most effective means to distribute information about our favorite hobby, radio via hamsats. Check out the net listings and join us! 73

***Photo C.** Marty Smith WD5DZC takes care of phone check-ins and material content.*

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Build an offset attenuator

Has your club held its first hidden transmitter hunt of this spring yet? In recent months, "Homing In" has thoroughly covered special transmitters, controllers, and portable antennas for radio direction finding (RDF). With these items and the two-meter handie-talkies that almost all hams own nowadays, your club is almost completely equipped to start on-foot fox hunting, sometimes called fox tailing, radio-orienteering or ARDF. But before you're ready to go out and bring home the trophies, you will need one more accessory.

The fox's signal at the start of a hunt may tickle your receiver with only a fraction of a microvolt. But when you get in close, your handheld could get pounded with nearly a volt of RF, even if the transmitter is running low power. The S-meter circuit of a typical VHF-FM rig won't help you get bearings at that level. It probably reaches full scale at 10 microvolts, giving only about 30 dB range from minimum to maximum. Limited range is good because it's easy to see the meter peaks when you swing a directional antenna, but it's bad because your meter will stay pinned when the signal is strong.

An RF attenuator is a device that goes between antenna and receiver to reduce the signal strength down to within the range that the receiver S-meter can handle. Without one, you may think you're close to the fox when indeed you're still far away, and you won't be able to get close enough to a camouflaged/hidden T to identify it. The amount of attenuation should be adjustable so that you can add from just a little when your S-meter first pins, up to a lot as you get within a few feet. Special ARDF receivers used by champion fox hunters have electronic attenuation built in, but ordinary handie-talkies don't. Adding it would require major micro-surgery in the HT.

***Photo A.** This offset attenuator for two-meter fox hunts is easy to build from parts you can probably buy in your home town. Photos by author.*

To solve leakage, QSY

External resistive (sometimes called "passive") attenuators are popular for mobile T-hunts. They have several shielded sections, each with resistors to soak up the RF signal and a switch to put the section into and out of the line. But they are not the answer for on-foot hunts, because handie-talkies and scanners are notorious for poor case shielding. A passive attenuator cuts down the RF voltage into the antenna jack, but strong signals will still penetrate the case and pin the S-meter.

A better way to get bearings on nearby foxes with HTs is to convert the strong on-frequency signal into a weaker off-frequency signal. Then you can tune your receiver to the offset signal and measure its strength versus direction, either with a dedicated RDF antenna or the "body shield" maneuver.

When this type of device was originally described six years ago by Anjo Eenhoorn PAØZR, it was called an active attenuator. Since there are other kinds of attenuators that are also called "active," I prefer to call it an offset attenuator. That term describes how it solves case leakage by offsetting the signal frequency. An offset attenuator consists of a local oscillator (LO) connected to a diode mixer through the attenuation control. The higher the LO level, the higher the amplitude of the offset signal applied to the receiver. To increase attenuation, decrease the LO signal into the mixer with the control.

The offset attenuator of **Photo A** is so easy to build that it makes a good project for every member of your club, especially if experienced builders help out the first-timers. You can obtain all parts for about $20 from your local Radio Shack™ store. RS part numbers for the components are included in **Table 1**, the parts list. All items should be in local stock except X1, which will be shipped directly to you a few days after you order it at the local store. There's nothing about these items that is exclusive to The Shack. You should be able to find equivalents for all of them at most electronics parts outlets, and perhaps at lower prices.

Nowadays, hams expect a special circuit board for every ham construction project. Not this one. There is so little wiring that it simply isn't necessary.

Parts List

C1, C2	470 pF ceramic disc (RS# 272-125)
C3	.0047 µF ceramic disc (RS# 272-130)
R1, R2	2.2 k 1/4 W (RS# 271-1325)
R3	4.7 k 1/4 W (see text)
D1	1N4148 diode (RS# 276-1122)
J1	UG-1094 BNC socket (RS# 278-105)
VR1	5 k audio taper potentiometer (RS# 271-1720)
S1	Toggle switch (RS# 275-625A)
U1	7805 regulator, +5 V (RS# 276-1770)
X1	4.0 MHz oscillator (RSU1321221)
Enclosure and board (RS# 270-283)	
Battery connector (RS# 270-325)	
Knob (RS# 274-424)	
BNC Cable (RS# 278-964)	

***Table 1.** Parts list for the offset attenuator.*

A universal project board works just fine. I used Radio Shack #270-283, which is a 2- x 3-1/4- x 1-3/8-inch plastic box with an aluminum cover and a pre-drilled 1-7/8- x 3-inch circuit board mounted inside. J1 is a BNC connector to mate with the cable from your RDF antenna. The output cable has a BNC plug to match the antenna connector of many handhelds. If your antenna or radio uses different connectors, make changes accordingly.

Radio Shack carries two types of rotary potentiometers, linear taper and audio taper. Audio taper is best for VR1 because it spreads out the high attenuation values on the dial when you wire it so that high attenuation is on

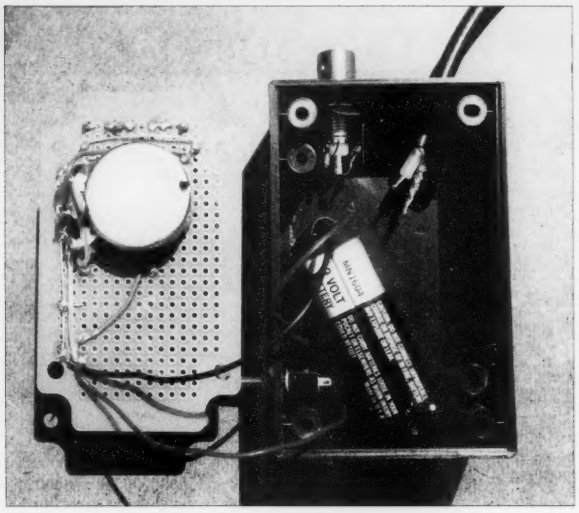

Photo B. *Interior of the attenuator showing a rear view of the circuit board before final assembly.*

the counterclockwise end, like a volume control. If you don't have a stock of quarter-watt resistors in your junk box, buy the five-pack of 2.2 k resistors. For R3, use two of the 2.2 k resistors connected in series.

S1 is a subminiature toggle switch. It's easy to accidentally bump it to the ON position when you pitch the unit into the back seat after the hunt. If you are good at making square holes, you can replace S1 with a slide switch to minimize the chance of accidentally run-down batteries.

Step-by-step construction

Cut the shaft of potentiometer VR1 to 5/8 of an inch, as measured from the outside end of the bushing. Following **Photo B**, drill a 5/16-inch hole, one inch from the top edge of the circuit board, centered between the left and right edges. Drill holes in the box for the coax receptacle (J1) and the RG-58 output cable (a BNC jumper cable with one connector cut off). Drill a hole for power switch S1 in the lower left side such that there is plenty of room for the battery and VR1 when everything is assembled. Mount VR1, J1, and S1, oriented as shown. The copper etch on the circuit board goes on the same side as the body of the potentiometer, toward the interior of the box.

Strip the center conductor and braid of the output cable as shown. Solder a one-inch bare wire to the ground lug of J1 and connect one end of C1 to the center pin of J1. Extend the bare wire and unconnected end of C1 upward, to be connected later.

Mount U1, X1, D1, C2, and the three resistors on the top (no copper) side of the board with the leads extending through holes to the copper etch side, per **Photo C**. Install two terminal pins (RS #276-1987) on the input (signal and ground) for later connection to J1, and two pins on the output side for the wiring to P1. Wire the pins and all the parts on the board per the schematic diagram, **Fig. 1**. Tie all the ground nodes together with bare wire. Install C3 on the rear of the board from the clockwise lug of VR1 to the crystal oscillator output. Use insulated wire for jumpers and the regulator output.

The crystal oscillator is designed to fit in the same board space as a 14-pin dual-inline IC. One corner is squared instead of rounded, corresponding to the location of pin 1, which has no internal connection. There is also a marked dot on top of the cover at this location. Counting clockwise from that pin as viewed from the bottom side of the oscillator, the next pin (7) is ground, the next (8) is the output, and the next (14) is supply +5 V.

Wire the battery connector and S1 into the circuit. If you have a voltmeter, turn on S1 and check for +5 V at the regulator output pin. If you have an oscilloscope, verify a 5-V peak-to-peak square wave at the oscillator output pin. Turn off S1 when you are finished.

Now it's time to put it all together. Solder the center conductor and shield of the output cable to the output terminal pins on the etch side of the board. Put the board in the box, extending the leads from J1 through the holes on the top left. With the board mounted in place with two supplied screws, tack-solder the J1 leads to the input terminals. Drill a 5/16-inch hole in the aluminum box cover, 1-1/16 inches from the top, centered between left and right, to clear the shaft of VR1. Make cover labels using your favorite technique, then install the cover and knob.

Antidote for overload

Using an offset attenuator for on-foot fox hunting is easy and efficient, once you get the hang of it. An S-meter on your receiver is a big help in getting RDF bearings with this attenuator and a small beam or quad, but it is not mandatory. You can open the squelch and use the quieting property of FM signals to get a good idea of signal direction.

At first, get bearings on the fox's frequency with S1 turned on. Start with the dial full clockwise, which is minimum attenuation (about 4 dB). Increase attenuation as necessary by turning the knob counterclockwise. When it reaches the stop, you have attenuated the signal about 20 dB.

When this isn't enough attenuation, tune your receiver up or down to the first offset frequency. (Examples: 146.565 + 4.0 = 150.565 or 146.565 - 4.0 = 142.565.) Return VR1 to full clockwise, which is the equivalent of about -30 dB, and continue the hunt, increasing attenuation as you approach. By the time you reach 100 dB, you should be within a few feet of the signal source, depending on its power and antenna configuration. Considerably more than 100 dB effective attenuation can be achieved with this unit, but that was the limit of the calibrating I could do with my milliwatt VHF signal generator.

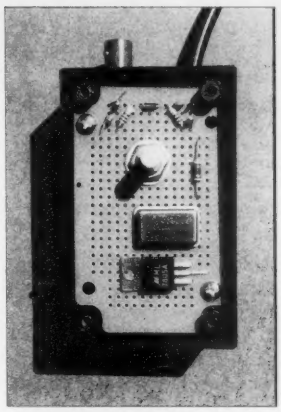

Photo C. *The circuit board is installed and the input wires are attached to terminal pins.*

This offset attenuator can be used with any VHF transceiver or scanner radio that has a removable antenna. Provisions for attaching to sets with integral antennas (such as the Alinco DJ-C1T and DJ-S11T) are not included. The receiver must have

Continued on page 78

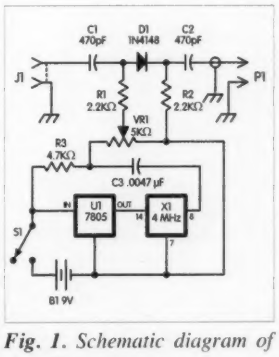

Fig. 1. *Schematic diagram of the offset attenuator.*

HOMING IN

continued from page 77

sufficient frequency coverage to permit tuning it 4 MHz away from the hunt frequency. If your handheld does not have an extended range receiver (the Radio Shack HTX-202 is an example), find a lower frequency oscillator module. Radio Shack sells a 1.8432 MHz module (RSU 11321205). It is not easy to quickly add or subtract 1.8432 to the hunt frequency in your head, so calculate and program the proper offset frequency into a memory channel in your handheld before the hunt.

The current drain of this unit is 27 mA, so expected battery life is about 15 hours. CMOS oscillators that have much lower current drain than the Crystek unit sold by The Shack are available, so check other parts suppliers. I found a 2 MHz module at Fry's Electronics that draws less than 1 mA. Another way to improve battery life is to replace U1 with a "low dropout" regulator such as the LM2931A2-5.0. This makes it possible to use nine-volt batteries down to about 5.5 V instead of 7.5 V.

Offset attenuator operation may be degraded on frequencies that are an exact multiple of the oscillator, such as 144.0 and 148.0 MHz. If there is a strong communication or paging transmitter that offsets onto the frequency you are monitoring, you may experience cross-modulation interference. An example would be QRM from NOAA weather radio on 162.55 MHz when you are hunting a 146.55 MHz signal by listening on 150.55 MHz. This effect is worse with odd multiples of the oscillator frequency and oscillators below 4 MHz.

Avoid transmitting through this attenuator. Your antenna will emit strong spurious signals and you may burn out D1. Set the power output down to the lowest possible level on your handheld. Fortunately, if you forget and cause a failure, repairs are easy and inexpensive.

There is no isolation between the mixing diode and your antenna. Offset signals not only go into your receiver, but they also go back to your RDF antenna, where they are radiated. This may cause cross-modulation QRM to nearby receivers, even outside the ham bands, when you are very close to the fox antenna.

Remember that an offset attenuator does not greatly reduce the level of on-frequency signal into your radio, so it does not provide protection for your receiver's front end. If you touch your RDF antenna to the antenna of a powerful fox transmitter, you may damage both the receiver and the offset attenuator.

Championships on the horizon

The first International Amateur Radio Union (IARU) Region 2 (North and South America) fox hunting championship has come a big step closer. At January meetings, the ARRL Executive Committee and Board of Directors approved a motion that strongly supports the development of radio-orienteering. It authorized the ARRL's president to appoint an ARDF coordinator for the purpose of promoting this radiosport in the United States, in concert with IARU leaders and member-societies here in Region 2 and in other parts of the world. President Stafford asked me to serve as the first USA ARDF coordinator and I accepted. I look forward to working with ARRL leaders and many "Homing In" readers to increase awareness and participation in ARDF activities all over the country and the Americas.

You can see the entire ARRL resolution and learn more about plans for the 1999 IARU Region 2 Championships by visiting the "Homing In" Web site. Don't worry, this does not change anything about these "Homing In" columns. I plan to continue bringing you news and projects for all kinds of RDF every month in *73 Magazine*. 73

Number 78 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net]

Tie an inky ribbon 'round the platen, please!

In past months, we have been looking at many high-tech RTTY items, from computer software to the Internet, from packet interfacing to frequency search engines. This month, a giant step into our roots, with a look at teleprinter ribbons.

Several readers have asked about the availability and maintenance of ribbons for mechanical teleprinters.

For example, Stanley Wilson AKØB has been looking for a source of teleprinter ribbons as well as a way to "refresh" a dried-out ribbon.

Casting about a bit, there really are quite a few sources, even today, for teleprinter ribbons. Several mail-order firms stock ribbons for everything from an old Model 15 through the Model 43 and beyond. Be on the lookout for Best Impressions, Global Office Supply, and DARTEK of Naperville IL [http://www.dartek.com/] as possible sources.

Of course, old Underwood typewriter ribbons have always been the traditional replacement ribbon to pick up at the office supply house for your Model 15 or Model 19.

If you have one of the major office supply houses nearby, such as Staples, Office Max, or Office Depot, be aware that, for example, a Dataproducts #R3300 all-black ribbon is available and fits the Teletype® Model 28 series. The Pelikan brand ribbon number Z470 is specified for the Okidata series 80, 81, and 82 dot matrix printers, and is fine for Teletype Models 28, 32, 33, and perhaps others.

Now, just in case someone should try to sell you a bunch of old surplus Teletype ribbons, sealed in a cellophane bag, "just say 'no.'" Cellophane is hardly impermeable, and many such ribbons have been tossed out as dried out and unusable.

There is a question about the relative merits of the traditional cotton ribbons and some of the newer ones, which are often nylon or rayon. With limited usage you won't notice much difference between cotton and the rayon or nylon types, but the nylon/rayon ribbons print much lighter than the cotton ones. Many of the 32s, 33s, and 38s don't provide much of a "smack" for the typewheel to make an impression, so to make up for this, many folks misadjust the mechanism—which wears out the ribbon, typewheel, and print hammer more quickly.

The supplies practice for Bell System Teletypewriters specifies that ribbons used for Models 15 through 37 be made of cotton and be inked from medium through heavy.

Years ago, ribbon wear was evaluated on Model 35ASR machines in use at the Addressograph-Multigraph Co. The question was, just how did cotton ribbons compare to the nylon/rayon type. The results varied by machine and operator, and the number of copies in the forms. However, on average, the nylon/rayon inks would be used up in about two to three weeks, whereas the cotton heavy-inked ribbons would last five to six weeks or more.

If you have an old ribbon (and who running teleprinters doesn't have at least one on the shelf?), you may have thought of trying

to restore it to function. Many folks have tried contact cleaner spray or WD-40® lubricant. A light spray of either, allowed to "wick into" the ribbon, can restore the function for many hours. They do evaporate after a while, though, so you may have to repeat the process. A more standard "rejuvenator" for old ribbons is glycerin. You can normally buy it at your local pharmacy. Just put a few drops onto the edge of the reel, and let it seep in.

On the other hand, you might actually want to try re-inking an old ribbon. While there once were, and still may be available on the surplus market, real teleprinter ribbon re-inkers, several folks have tried some new ideas. There are those who have picked up stamp pad re-inkers and are experimenting with those to re-ink ribbons. Another fellow wrapped one of the ribbon guides on the machine with a piece of felt, then soaked the felt with stamp pad ink, using a dropper.

Apparently the cotton ribbons take more ink but wear out more quickly, while the nylon ones last longer but hold less ink. I guess it's all what you get used to.

My sincere thanks to Stanley Wilson, Don Robert House, Daniel T. Ruth, David Ross, Bill Nelson, Edward Greeley, Jack Hart, Bob Roehrig, Richard M. Gillingham, Steve Rohrer, Bud KV7G, and the others who added thoughts to this thread. I look forward to hearing from you all, as well.

Now, I can't stay away from the more modern for long, so let me respond to a question posed by John Burch WB6GHA (formerly WN6GHA), who wrote:

"I'd like to pose a question to you, based on the unique position that you have which allows you access to so many of the Green Keyers out there ...

"Let's say I had the traditional (before SoundBlaster®) RTTY setup where I had a TU of some sort driving the 'usual' 60 mA loop in which a page printer and maybe a TD (tape reader) or some such were hooked in series, just as God had intended.

"And now it's 1998, and I have this brand new PeeCee 'IBM-Compatible' thing in the shack. I have decided that, in the 21 short months before all of the world's computers die from the Y2K problem, I want to hook this PeeCee thing in series with the loop that 'runs' the rest of the RTTY gear here in the shack.

"Setting aside for the duration of this conversation all of the issues of interfacing the PeeCee to the loop, I know that I will need some sort of software to allow the PeeCee to both send and receive.

"My question to you is this—what are the more popular programs out there to perform these functions?

"I'm most interested in programs that are still available and hopefully 'supported' or at least well documented.

"The number of additional features such as multiple type fonts and three-language spelling features are not that important.

"Of particular interest would be your recommendation of those programs to *stay away from* for whatever reasons!"

Well, John, there are any number of programs which are around and can fill your needs. There are simple programs like TRTY and AutoRT, both of which are on the first disk of the RTTY Loop Collection and can run RTTY with a plain terminal unit and simple interface to the computer. Many hams have used HamComm with quite a bit of success, and there are other programs like RAFT and RTTY12G which will also run with only an external terminal unit. The nice thing is that all of these programs are easily available, either on-line at various sources or as part of the RTTY Loop Software Collection. Check the RTTY Loop Home Page, at [http://www2.ari.net/ajr/rtty/] for the complete listing of software available, and follow the simple directions to obtain a program disk. Readers without Internet access can send a self-addressed, stamped envelope to the snail-mail address at the top of this column for a printed listing and instructions. I try to include new finds as they surface, so stop back every now and again and have a peek.

Next month, more of interest to you and me, as we continue to look at this unique facet of amateur radio and this column completes its twenty-first year of publication! 73

LETTERS

continued from page 6

woods, trying to get the "code codgers" to help upgrade skills is nearly impossible. They'd rather sit and talk about the "good old days" and whine about how terrible everybody else is. I am fortunate that my club does have a pretty strong group that does help out. We have a group of 20 or so that are all hard at work upgrading our skills thanks to the folks willing to help out. (3) I don't know how to respond to your complaints about the ham who wants to *really* talk to the guy on the other end of the radio wave. I thought that this hobby was about communicating with people. If the two parties want to rag-chew about their kids, who the hell are you to feel put upon? Spin the dial and find someone else to talk to if all you want to do is exchange callsign and RST.

Wayne, I'm glad that folks like Doc are a minority. As I've learned code, built my antennas, installed equipment and operated over the last year, I've met nice supportive folks on the bands (particularly the CWers). I had only one guy throw up his "hands" with my code about a week after I got my Tech Plus. Heck, I didn't blame him a bit. I was terrible! But all those many people that stuck with me are appreciated and you can be sure that I'll be around to help others getting started. When the hobby gets so frustrating that I have to snivel in a national magazine, I'll find something else to do.

Ed. note: We published the "Letter From Down East" as a humorous piece, but ...

Howard White VE3GFW. Here's a letter I wrote to *QST*. I doubt they will print it.

"Dear Sirs: I have been a life member of the American Radio Relay League for more than 25 years. I recall that ham radio was once the leader in technological innovation. Because of this leadership, it was the beginning of my interest in electronics in the 1950s. In the last few years, my own interests have been in the applications of computer systems and my interest in radio has for the most part been supplanted in the mid-1960s by more innovative technologies.

"I must admit that I have not been involved much in ham radio very much since the invention of the cellular telephone took away my spare time in my automobile. For the first time in a very long time, I picked up a copy of *QST* and actually read it. I was appalled to see that *QST* had a feature article on how to make a Morse code key.

"Wake up and smell the roses! Morse code keys? You've got to be kidding! Why not horse & buggy whips or spark gaps? No wonder ham radio is dying as a hobby. Your article on Morse code keys was followed by a very basic article on how to put together a computer. That article is only 20 years too late.

"If you guys are supposed to be the leaders of ham radio's charge into the 21st century I guess that I should dig a hole and bury my rig. What a pathetic showing! How about articles on things that are relevant to the modern world. Spread spectrum? Low orbit satellites? Internet interfaces? How about articles that might excite youngsters to get

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LETTERS

Continued from page 79

interested in electronics like ham radio did for me in the 1950s. But Morse code keys! I am embarrassed to be associated with you. Need I say more?"

John R.C. Crabtree, Edina MN. I could not agree more with your editorial on the ARRL as a publishing company. While it is admirable that they are a source of technical information, I find several aspects of their modus operandi to be infuriating:

1. I have a feeling that they are trying to sell as many books as possible. Any publishing company would. To this end, they keep referring you to another book. How many times have you seen in the *ARRL Handbook* words to the effect that further information can be found in "xyz" book? Understandably, many of these other books are not readily available at local libraries.

Right now, too many of their titles are still in print. For example the better material from the five "Antenna Compendium" books should be incorporated in the *Antenna Book* and the earlier volumes allowed to fade away. The latest version of the catalog no longer shows the original publication dates!

2. The idea of being a publishing company leads to a new *Handbook* each year with minor changes. The ARRL is as hung up as the auto companies, in wanting a "new" model each year. The RSGB is now on the sixth edition (too few) of its handbook which was first published in 1938. Every three years should be fine, but it would, no doubt, mess up the ARRL revenue stream.

3. I am insulted by the comment which I found in the second printing of *Solid State Design for the Radio Amateur*. In the foreword it says "In this second printing, the occasional errors and omissions which inevitably creep into a work of this magnitude have been corrected, making the publication more valuable to its intended audience."

Does this mean that I should not buy the first printing of any ARRL publication? Am I supposed to accept that their books contain errors, and then have to work them out for myself?

4. Some of the editing of these books is atrocious. I understand from a post by Bill Sabin, WØIYH, to one of the [rec.radio.amateur.homebrew] [postings] that authors are not paid for updates to their chapters. I quote from his post, "I had a very similar experience with Chapter 17, which I try to update a little each year (no payment)."

This places an even greater responsibility on the ARRL editors to do a thorough job. Otherwise mistakes can get passed from year to year. For example, equation 5 on page 10.7 of the 1998 *Handbook* is incorrect and does not agree with the text. The same error is in the 1995 *Handbook*. In other parts of the book they have not always followed their convention in putting references to the figures in bold type. Book references have not been checked and updated. In section 30.5 they do not give the address of Rockwell Collins, cited in Chapter 17. In the same section, they ask for updates to be sent to the ARRL. Why are they not checking this stuff and finding out details of the Web sites too? 73

Joy's "Loud Enough" Metronome

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for 15, 30, or even 60 seconds. Apply the correction factor. Multiply the number of pulses by four, two, or one, to get the number of beats per minute. Then mark the scale on the box.

For the simple, basic bare-bones model, this may not be too bad. If you want a slightly more accurate model—one with presets—see if you can find (a friend with) a frequency counter. Most of the benchtop models will have a "period" function. That will let you measure the time between pulses. **Table 5** gives the number of beats per minute for the period or the time between pulses. It also contains the 34 standard tempos.

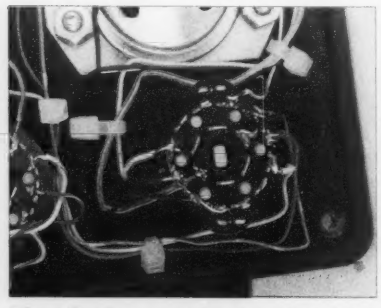

***Photo G.** Close-up of function select switch in deluxe model.*

At this point it looks like we could use some words of explanation about the differences between **Table 4** and **Table 5**. **Table 4** up through the 220 mark represents the standard marks as often listed in textbooks. I added the other two marks in order to fill out the 36 positions on the three switches. **Table 5** lists the marks I wanted to use in Joy's deluxe version, but a close look at **Photo D** will reveal that in actuality I ended up using a combination of marks from both tables. **Table 5** also shows the settings for the frequency counter if you use one to adjust the timing.

Making your mark

On one of the early iterations, **Photo B**, I used a felt-tip marking pen: crude, but effective. That explains why you cannot see the top of the box. A plastic embossing tool will give durable marks, as will an electronic labelmaker. This last option will let you make small enough labels if you want to crowd several marks together. On the variable control, the timing marks get crowded near the high end. A metronome with presets will allow uniform spacing between timing marks.

Using the metronome

While I can give you information on how to make a loud enough metronome, I will have to suggest that you check with a music teacher for the specific techniques used to get your own timing where you want it. Maybe with one of these "loud enough" metronomes, you can do it.

I have been getting assistance from Joy. One of these days I hope to pick up the flute and get the timing right myself, so that she will quit telling me, "No, Dad, that's supposed to be one and, two and, three and ..." 73

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show this FCC mandated tax on their phone bills so you'd be aware that you've been taxed. The FCC balked, with the final agreement being that business customers will have the tax itemized on their bills, but not residential customers: you.

The motives for this FCC-sponsored social legislation may be worthy, but that doesn't make it either ethical or constitutional for them to impose a tax on us for this social service. This is just one more hidden tax that we're all going to have to pay. If schools want more computers I've proposed in my past editorials a practical way for them to get the latest and greatest computers for almost nothing.

In another vigorous bending of the rules, the FCC has decided that passive radar jammers are illegal. Yep, they've decided they can regulate not only the transmission of radio waves, but reflected waves, too. And their "laws" are, practically speaking, unchallengeable since they have unlimited funds to prosecute (persecute?) offenders.

As a practical matter, please keep the above to yourself. Since we hams exist only at the sufferance of the FCC, we don't want to bite the hand that's feeding us. Unfortunately, I've a long history of vigorously biting the hands that feed me — when I think they need biting.

Communicating With Plants?

Okay, okay, so I've read another book. Well, the ad for it was intriguing in the Dowsers catalog. It's Bennett's *How to Communicate With Plants and Animals*. Having read *The Secret Life of Plants* by Chris Bird many years ago (it's reviewed in my *Guide*), which provided convincing proof that people and plants can communicate, and also having read and recommended *Kinship of All Life* by Allan Boone, which explained how anyone can learn to communicate with animals, I just had to spring for the $4.50 for this new book. Money well spent.

I've explained how I used Boone's system to communicate with flies. Before that I'd had to have fly swatters in every room during the summer. In the three years since reading the Boone book I haven't had one single fly come into the house.

I haven't told you that I used the same system with ants. Before that there was a yearly trail of ants checking out not just the kitchen, but even into the bedrooms. Not one ant in three years now.

So I wanted to see what system Bennett used to communicate with plants and animals. His approach is different from Boone's. Bennett uses dowsing rods. With them he explains how you can find out whether a plant needs more or less water, how it likes its soil, and even if it prefers to face a different direction. Is it comfortable with the sun it's getting? Is it too cold or hot?

In some way your pets are tuned to you. Many owners find their pets right there waiting for them when they come home, no matter the time. And there are endless stories of pets who have tried to get their masters not to make a trip where they were going to have an accident. And pets somehow know ahead of time about earthquakes. Bennett's system will allow you to communicate with your dog or cat.

He doesn't go into it, but remembering the Bevy book *Psychometry,* I'm sure you'll learn how to communicate with things like trees, rivers, and even rocks. Go ahead and say it, Wayne's off his rocker. I don't mind, as long as it doesn't stop you from getting the book and giving the dowsing rods a try. You can make a pair from a couple of wire coat hangers.

You can get the book from the Dowsers Bookstore, (800) 711-9497. Tell 'em Wayne sent you so maybe they'll give

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CIRCLE 188 ON READER SERVICE CARD

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CIRCLE 193 ON READER SERVICE CARD

Magnets

I've reviewed a couple of books by Rawls and Davis on magnetism, and I've included them in my *Guide*, but that hasn't been enough to get you out of "park" and even into neutral, much less first gear. Well, here goes again. I've just read Rawls & Davis' *The Magnetic Effect*, Acres USA, 128 pp., 1975, $15. It's #701 from Acres USA at (800) 355-5313.

Not only does a magnet substantially affect the growth of seeds and plants, it also can be used for healing a wide variety of illnesses. You use a bar, not a horseshoe-shaped magnet, so you can isolate the effects of the north and south poles. You see, the north pole tends to slow growth and the south pole to increase it. For instance, in the case of cancer you want to stop the growth. A south pole will speed up the healing of cuts and burns. It's almost like magic.

Even more remarkable, you can magnetize water and see the difference when you use it on seeds and plants. Once you read about it you'll be doing as I do and putting the north pole of a magnet under your bottle of distilled water before you drink it. Kids may want to set up a simple science fair project with seeds watered by north and south pole waters, and compare their growth with unmagnetized water for the control plants.

I don't want to give everything in the book away. By reading it you'll know more about magnets than 99 out of 100 scientists. And you'll see why I've been pestering Don Lorimer (Mr. Magnets) to get busy and write a 1998 book on the subject.

DEET Can Kill!

Hey, I've been warning you about insect repellents and how they can be absorbed through the skin. Just because water doesn't go through easily doesn't mean that a lot of other much more dangerous stuff won't. Try daubing on some DMSO and smell your breath a few minutes later to get a hint.

Anyway, the American Academy of Pediatrics has warned us not to use any products with DEET™ in them on kids under five. In 1995, 64% of the people reporting serious side effects to insect repellents were under the age of six. One man of 34 was killed by DEET. An ABC-TV documentary reported a 26-year-old man dying after two sprays with DEET. An eight-year-old boy suffered seizures.

Be as careful about what you put on your skin as you are about what you put in your mouth. I listed some of the ingredients in *OFF!*™ a while back. And then there is all that aluminum in deodorants. Just what you need to help with your potential unmemorable Alzheimer's trip to a rest home as a veggie tied to a rocking chair for a few years. Say, have you bothered to visit a nursing home recently? It might even get you to start considering making some diet changes. But I doubt it.

Fox Hunting

The Garden City ARC newsletter mentioned that they are running fox hunts once a month. I wonder how many clubs are doing this? I sure don't see much of a sign of it in the club newsletters I'm getting. Yes, I read the newsletters.

How about some letters or articles for *73* on fox hunting? Maybe you've had some interesting adventures? Found some unusual places to hide the fox? Are your members doing all their hunting from cars or are you making them get out and walk? I think the US is the only country where much of the fox hunting is done in

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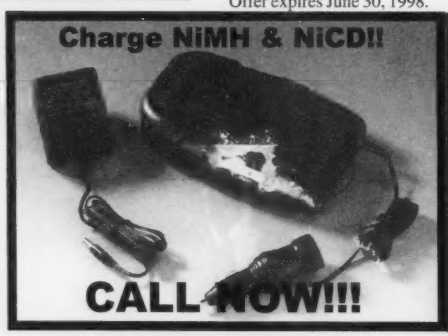

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cars. Hams in most countries are out there on foot. It's good exercise for some of you pork-bellied hams.

What equipment are the winners using?

Have you considered doing some videos of your hunts? I'd love to see some. I'll never forget a Philmont film which showed them hiding the fox in the women's toilet of a police station, with the coax going out the window, under a lake to the antenna mounted under a little bridge. The hunting cars drove over the bridge, with their antennas twirling to keep on target.

Ham clubs are desperate for entertainment, so if you can whup together some fun fox hunting material and make copies available, I think you'll get a lot of good PR for the club. You might even find other local clubs interested in seeing it too, like Lions, Elks, Chamber of Commerce, Rotary, etc. Heaven knows amateur radio can use the publicity.

Shot Causes Autism!

Five recent studies show that the measles-mumps-rubella (MMR) vaccination can cause autism and Crohn's disease in children. Is that a gamble you're willing to take with your kids and grandchildren? These are not very dangerous childhood diseases which, if allowed to happen naturally, will protect the kids from getting these diseases later on, when they can be much more serious. I had the measles at four and the mumps at 10. Both made me sick for a few days. The only thing I remember about the mumps, when we were living in Washington DC, was watching the airplane flying over and describing on the radio FDR's inaugural parade in 1933 from my bed. A radio broadcast from an airplane was unusual in those days.

Well, you probably say, since you are annoyingly argumentative, at least the vaccination will protect you from these diseases when you're an adult. Oh yeah? A recent outbreak of measles in Greece put 79 adults into the hospital and 76 of them had been immunized.

The fact is that any vaccination can have long lasting unforeseen results. But can I get you to read Wallene James' book on the subject? Not when there's a Broncos game or something on, for sure. Yes, the book is listed in my *Guide*.

Skin Cancer

Dr. Lorraine Day, in a fascinating interview on the Art Bell show, cited a Baylor University animal study where one group of rats was fed the standard American diet of junk food and a second group was fed a nutritious diet. Both groups were exposed to high intensity ultraviolet light. Twenty-five percent of the animals eating sugar, white flour products and meat developed skin cancer. None on the nutritious diet did. None. And that backs up the information in the books reviewed in my *Guide* by Ott and Lieberman, and the advice from Dr. Douglass, in whom I have a lot of confidence.

Dr. Day went through the standard medical education, which concentrated in treating symptoms, not the causes of illness. And then she came down with cancer. It came within days of killing her. If you think I'm exaggerating you can check the photos of her with a grapefruit-sized tumor via Art Bell's Web page [artbell.com]. There's also a photo of her after she cured herself by rebuilding her immune system.

Her prescription, I was delighted to hear, is exactly what I've been preaching. She cut out all sugar and white flour products, and poisons such as coffee, cigarettes and alcohol; she drank around 20 glasses of water a day; got lots of sun on her body and into her eyes; exercised; and did her best to eliminate stress. She ate raw fruits, raw vegetables, and grains. No milk products. No meat. No hot fudge sundaes.

If there's any part of that list that you want to argue with, please check my *Guide* for a book which goes into details on that subject.

I've been recommending eight glasses of distilled water a day, but she drank 20 glasses a day as a way to rebuild the ability of her body's cells to absorb and hold water after having been shortchanged for many years. Good plan. Yes, it does have you going to the bathroom pretty often.

The lifestyle change it takes to keep from getting sick and dying early is a major one. Having made it myself, I can understand why many (most?) people prefer to get sick and die.

Will Art Bell W6OBB be able to change his dependence on coffee, cigarettes, alcohol and hamburgers? He's 53 now, so all this could catch up with him pretty soon.

Nag, Nag

A *British Medical Journal* report of a long-term (17-year) study showed that eating fresh fruit daily substantially reduces the risk of death. Those eating fresh fruit daily have a 32% lower rate of death from strokes, 24% from heart disease, and a 21% lower rate from all other causes compared with those eating fresh fruit less often. Dr. Douglass (of *Second Opinion*) recommends we eat three apples a day. I eat at least one orange and banana a day, two or three apples, and some grapes or a grapefruit.

A Cambridge (*Lancet*) study showed a 77% reduction in new heart attacks when a 400 or 800 IU vitamin E supplement was taken every day. Two hundred milligrams or more of vitamin C daily also lowered the risk of other illnesses. I take 1000 a day. Many studies show that daily exercise increases longevity and greatly improves the quality of life later on. I jog a couple miles most days, but I should do it twice a day.

Then there's a *British Medical Journal* report showing a direct relation between hip fractures and smoking. Smoking somehow acts on the bone minerals, decreasing them by 2% for every 10 years one smokes, which probably explains why my father broke his hip after a small stumble at home when he was 70. He smoked Camels and died of emphysema, after living (sort of) several years connected to an oxygen bottle.

Great Minds

Great minds tend to run in similar ruts, so I was delighted to see a column by Thomas Sowell on what he would do if he were president. If there ever is a demand for someone with serious brains for the job, Sowell would make a good candidate. One of his books is recommended in my *Guide*, and I probably should add a couple more. Anyway, one of the moves he says he'd make as president would be to make it so all politicians could serve for one term only. This is what I had in mind when I proposed that we adopt NRA as our strategy: Never Re-elect Anyone. Get the pros out of our government. This would eliminate all that re-election campaign fund soliciting corruption and pretty much kill the lobbying business.

Sowell would also shut down all schools of education (teachers' colleges). My *Guide* recommends Sowell's *Inside American Education* and Kramer's *Ed School Follies* for anyone who doesn't know what a ghastly waste of time and money ed schools are. Sowell says he'd pay every ed school professor a million dollars to stop teaching and stop writing. He says that would be the greatest bargain we've ever gotten from our educational dollars.

While I like the idea, my approach would be different, with our schools being changed to the Sudbury Valley School system. Read *Free At Last* by Greenberg for the lowdown on this kind of school. It's turning out amazing graduates, and at less than half the cost of our public schools. Yes, it's reviewed in my *Guide*. And once you read that book, you'll want to do as I did and get the other seven books about this phenomenal

Continued on page 84

school — and then maybe start one like it in your area.

Hmm, That's Odd!

With the approaching millennium I've been reading some articles on the technology wonders of the 20th century. Like the transistor, which has resulted in incredible changes in communications, entertainment and computers. This remarkable discovery resulted in three Nobel prizes.

Wow, great for us, right? And great for AT&T, in whose labs the transistor was developed. But there's a teeny, tiny fly in that ointment. If you've read anything at all about research funding you know that in order to get funds a researcher has to virtually prove that the results will be as predicted. Yet here we have a case where three of the world's top scientists were suddenly funded on what could easily have been a wild goose chase. Not bloody likely.

More likely is Col. Corso's version, where he went to AT&T with an artifact from a crashed UFO and gave alien transistorized equipment to AT&T to try and find out what in the heck it was and how it worked. Actually, he says he took alien integrated circuits to them. This would explain the sudden crash program and the unheard of assignment of three top scientists to the project.

Corso was the officer at the Pentagon put in charge of foreign technology, so the recovered UFO equipment ended up at his office for a quiet introduction via military suppliers into the development of new products.

Corso claims he introduced transistors, ICs, lasers, night vision systems, and other advanced technologies.

Why the secrecy? Well, it makes sense that the Air Force was not eager to let the public know that they (we) were faced with aliens with vastly advanced technologies. Talk about panic! They wanted to do their best to catch up with the aliens so, if they turned out to be hostile, we'd at least have a chance.

Are Alien Implants Rubbish?

I'm not sure what it takes beyond a White House bimbo eruption to get the attention of the media, but I recently got a video showing Dr. Roger Leir removing tiny implants from a number of people — and then later listened to an interview with the doctor on the Art Bell (W6OBB) radio talk show. Quite a few people with abductee stories also have been found to have implants, some inserted when they were as young as four — usually in a hand, foot or toe.

If you think the abductee biz is just another *National Enquirer* bunch of hokum you haven't bothered to do any homework. Like at least read the Mack book on the subject (yes, it's reviewed in my *Guide*). This Harvard psychology professor decided to investigate what he considered aberrant behavior. It didn't take long for him to decide that abductions were real. It's a fascinating book and detective story.

The removed implants are of several kinds, with some showing evidence that they have microcrystal circuits in them which could be some sort of transponder. They are encased in a membrane which a surgeon's scalpel can't cut, but which is not rejected by the body. The substance is unknown to scientists, but if replicated could be of enormous value to surgeons. That is supposing that Dr. Leir can get anyone else to even look at them.

Maybe the conspiracy paranoia is catching, but right after I watched the implant video three things happened. Curious coincidences. One was that the video totally disappeared from my living room and has never shown up again. Two, I suddenly found an unexplainable little lump on my hand, between my thumb and forefinger. I've never had anything like that before and it's still there. Three, a friend who was visiting said that that night a black helicopter flew low over the house. He felt something was wrong about it so he drove down to New York a few days later, where an expert found and removed two implants from him.

Weird stuff. But, you know, the next time I'm at the hospital I'll ask 'em to X-ray my hand to see what that might be in there. Just in case.

A *Challenger* Conspiracy?

If the *Challenger* disaster was an accident, then why is NASA still covering up some key information? Damning information?

No, I don't sit up all night listening to the Art Bell show on AM radio, but I do tape it every night on my VCR. All five hours of it. In that way, when I'm doing routine no-brainer work I can listen, fast-forwarding through the commercials. That cuts the program down to more like two and a half hours. Skipping the random unscreened calls from listeners and listening mainly when he has interesting guests saves me even more listening time.

Anyway, while collating the pages of the reprint of my editorials for January through April 1998, my conspiracy theory flag went up when Art interviewed Ted Triedmeier, the chap who installed and was in charge of the data switching systems at the NASA launch sites. He explained that he'd installed a sophisticated system which monitored just about every conceivable aspect of the launches. The controls for the system were at the launch site, and thus required special clearance for anyone to access them.

On the *Challenger* launch he found that someone had, shortly before the launch, accessed the site and turned off the master switch for recording the launch data. This switch was protected by a cover so it could not be accidentally operated.

Ted pointed out that even a slight change in the timing of the release of the bolts holding the rocket down would have put a severe lateral strain on the engines, which were made in separate pieces, held together by the O-rings. A slight reprogramming of the bolt release sequence could have caused the ensuing catastrophe. But that would have shown up on the data record ... if the telemetry system had not been turned off.

NASA, according to Ted, was made aware of all this, but has never released any information on who turned off the telemetry or why. Or, for that matter, why the telemetry shutdown didn't stop the launch, which was what should have happened automatically. That safeguard, too, had to have been compromised.

There doesn't seem to be any non-conspiracy way to explain this, so what in heck has been going on at NASA (Never A Straight Answer)?

That Face

So there's this hill on Mars that, in a certain light, looks something like a face. Big deal. Big supermarket tabloid deal. Big Richard Hoagland deal, if you've heard him carrying on at great length about it. Serves me right for listening to him on the Art Bell show.

Hoagland puts Mel Gibson to shame as a conspiracy theorist. He believes there are cities on Mars and the Moon which are being covered up by NASA. Somehow he ties this together with the Masons. My father and grandfather were both Masons, but neither of them ever mentioned anything about the organization to me, so I guess I didn't measure up. But then I've never been a big joiner. I've managed to somehow not get involved with the Lions, Elks, Rotary, and so on, other than giving talks to these groups. Well, I did get involved with the Chamber of Commerce and quickly got to be the president (Peterborough).

Come to think of it, I've been made the president of most of the groups I've joined. Hmm, I digress, as usual.

Getting back to the so-called face on Mars. If, as NASA claims, there is nothing to it, then why have they announced that the latest satellite circling Mars will have its camera turned off while it is over the Cydonia area where the face is? Well, that's what NASA's Dr. Michael Mayland said. Now *that's* weird.

I can understand that NASA might say the camera would be turned off, but I'll bet it won't be. Thus, if they find clear signs of a current or past civilization they might want to keep that quiet.

Why? Because that would put on the pressure to send astronauts to explore it, and NASA, I suspect, knows that there is no way with our current technology to get anyone into space safely beyond the Van Allen belt. Moon rocks they could fake, but not the exploration of a city on Mars.

Or am I being caught up in the conspiracy theories too?

You, too, can really upset the believers in NASA and our having visited the Moon by reading René's *NASA Mooned America* and quoting his data.

Bombing Iraq

The Administration, aided mightily by our beloved media, have been whooping it up about Saddam's biological weapons, with few voices of moderation being heard. Yes, it would be awful if Saddam unleashed anthrax in a New York subway.

But even more in danger would be his neighbors. You know, like Iran. Saddam hates us something fierce, but I suspect that he hates Iran even more, and they're a lot closer and easier to deal with. Yes, even in the heat generated by the Administration over the blocked UN inspections, we weren't hearing about any serious concern from the other Arab countries. Oh, Kuwait sided with us (the only Arab country to do so), but then we saved their leaders' bacon (pardon the expression) eight years ago, keeping those despots in power.

What didn't get much coverage were the other countries strongly suspected of having biological weapons. You know, like our friends Iran, Libya, North Korea, Syria, China and Vietnam. Plus Russia, India, Egypt, South Korea and Taiwan.

Sure, there's an international agreement not to develop such weapons. But then we hear that the US has, despite the agreement, been designing, making and stockpiling the stuff for years in secret. And so has everyone else.

It's easy to make the stuff. You've probably seen the *60 Minutes* segment showing that the US sold Saddam anthrax and bubonic plague germs, all with not just the okay, but with serious pressure from our State Department to make the sales. It only takes a small area to make as much of this stuff as you want, so it can be made anywhere and quickly moved, if an inspection looks likely.

Delivering the stuff effectively isn't easy since daylight kills most agents, so it might not be as serious a threat as a revival of the Spanish Flu.

So, are we going to bomb the Chinese biological weapons plants (presuming that we can find 'em)? And how about all the others?

A recent article in the March 9th (1998) *The New Yorker* quoted the top Russian bacterial warfare scientist, who is now working for us, as saying that when the USSR fell apart the funding for bacterial warfare projects dried up, so he and the rest of the scientists involved headed for the countries offering them employment, taking along some starter viruses and germs to help get things going.

He told about their working on these agents in space suits and that one day one scientist had a needle prick his finger through the glove. He died a few days later oozing blood from his entire body. They have this stuff so it is microencapsulated to stay alive in the air and be carried by breezes for miles. Once you inhale the air you're done.

With normal anthrax it takes about 8,000 spores in the lungs to guarantee death. With Marburg Variant U anthrax it only takes one to five spores.

Other agents are Black Death and powdered smallpox. Now they've combined Ebola with smallpox to make it even more deadly.

Well, I thought you might like to know. Look up the article in the library if you're not a subscriber.

Korean Tunnels

My Congressman, Charlie Bass, gave a talk on his recent visit to North Korea. For some weird reason the first US delegation invited to visit this country was the House Intelligence Committee, so Charlie was there, armed with a video camera.

The camera was a good idea. If we hadn't seen his pictures to back him up, we'd have suspected he was exaggerating.

I read a lot, but I don't recall any reports in the media on what things are like in North Korea. The bottom line is: They're incredibly awful. The capital, Pyongyang, is almost a deserted city. There are a few people wandering around, but they are there for show only and have nothing to do. No one is allowed into the city from the rest of the country. There is no electricity anywhere in the country except in the president's palace. Charlie showed me a night satellite photo of the Korean peninsula, with South Korea ablaze in light, and plenty of light in China, but North Korea was totally black except for one light from the palace. With no electricity there are no radios or TVs. No telephones, no Internet, no faxes. There is no oil for lamps, either.

The people are not allowed to congregate and talk in any of the towns. They have to stay in their homes when they are not working in the fields. They used to gather around the town well, getting water. Then the government put in pipes to bring water to their homes so they wouldn't be able to gather at the wells.

Food is so short that the people are getting just a few hundred calories a day of rice and are slowly starving.

No small businesses are allowed.

One thing the North Koreans have been doing is secretly digging tunnels under the DMZ, presumably in preparation for invading South Korea. With Seoul only a little over 20 miles from the DMZ, there's considerable uneasiness about this. There are barricades set up over all of the major highways leading into Seoul, complete with explosives to quickly put the barricades into place. They had those set up when I visited the DMZ a few years ago.

I was lucky in that the head of the UN forces at the DMZ was a Danish ham and I was able to get on the air from his station. Hey, does that count as a new country, like those old 8Z Arabian neutral zones?

One of the big problems, Charlie explained, is that we don't know exactly where all of the North Korean tunnels are. I'm going to have lunch with him in a few days and explain how we can find this out, and then propose what can be done about it.

Ask me how we can locate a bunch of underground tunnels. Radar? Sonar? Nah, if you've been reading my editorials attentively as you should, you'd know the answer already. I wrote about this recently.

On page 11 of Chris Bird's *The Divining Hand* is the story of the famous Paris test in 1913, where dowsers precisely located a group of underground tunnels and old mines in Paris, some not even charted. A good dowser should be able to locate every North Korean tunnel and find its exact depth. And if it's too dangerous to walk around the

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NEVER SAY DIE

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area, the dowser can do just as well with a good map.

Once located, what should be done about the tunnels? My idea would be to set up a drill and put a pipe down into each of the tunnels. Maybe a four-inch pipe. Then I'd collect a few hundred thousand gallons of pig manure and start pumping it into the tunnels until they're full. If they run short of manure in South Korea I'm sure the good people of Georgia will be glad to ship over a few tankers of the stuff they have collecting around their big commercial pig farms. Maybe you saw the fuss over the pollution and stink on the *60 Minutes* segment.

This might turn the DMZ into De Manure Zone.

If the North Koreans complain we could explain that we are just re-fertilizing the ground.

Sometimes there are better weapons than guns and bombs. Sometimes it's better to outsmart an enemy than to outfight them.

The main problem is that the people of North Korea have no way to get rid of the government that is holding them prisoner. They are watched so carefully that they can't revolt, so there can be no uprising. They're too weakened by the food shortage anyway, and they have no means of communications with each other. Not even talking.

Their government has been busy selling missiles to Iran. They explain that if we want them to stop doing this then we'll have to buy their missiles, paying for them with food.

Huggable Wayne

At hamfests hundreds of hams come up to say hello and they don't just shake hands, they hug me ... and I love it! I love it because I know that the odds are that these are people who are healthier, wealthier and happier as a result of my editorials. The hand-shakers are people who enjoy my editorials, but haven't yet let me change their lives. The obese and smokers generally sneak by, avoiding eye contact.

Can I get you to stop poisoning yourself with sugar, coffee, alcohol, nicotine, and dental mercury? Can I get you to exercise every day, reduce your stress, and drink large quantities of distilled water? The results are worth it and you'll be in line to hug me at Peoria in September. You *are* going to come and see me at Peoria, aren't you? The hamfest is September 19–20th and I expect you to make a major effort to be there, armed with questions.

Yes, I'm playing the same health-wealth tune I lay on you every month. Hello, is anybody home? 73

SPECIAL EVENTS

continued from page 39

PHILADELPHIA, PA The Olympia ARC will operate WA3BAT 1300Z May 2nd–2200Z May 3rd, to commemorate the 100th Anniversary of Admiral Dewey's triumph over the Spanish Fleet at the Battle of Manila Bay. SSB/Phone—3.898.5, 7.248.5, 14.248.5, 21.368.5, 28.368.5, 145.270 FM; CW—7.030/.110, 14.030, 21.040/.110, and 28.025. For a certificate, send QSL and a 9" x 12" SASE to *Olympia ARC, Independence Seaport of Philadelphia, 211 South Columbus Blvd., Philadelphia PA 19106 USA.*

MAY 8–9

MIDDLEBOURNE, WV The Tyler County Amateur Radio Organization will operate KC8GXI 1400 UTC Friday May 8th–2200 UTC Saturday, May 9th, to commemorate the Tyler County Historic Museum Open House. Phone 3.860, 7.230, 14.270 and 28.320. For a certificate, send QSL and 9" x 12" SASE to *TCARO, P.O. Box 287, Middlebourne WV 26149 USA.*

MAY 9–10

OREGON QSO PARTY The Central Oregon DX Club, K7ZZZ, will sponsor the 1998 Oregon QSO Party 0000Z May 9th–2400Z May 10th. Suggested frequencies: CW—1.810, 3.540, 3.735, 7.035, 7.125, 14.035, 21.035, 21.125, 28.035 and 28.125. Phone—1.855, 3.905, 7.280, 14.280, 21.380, 28.580. VHF—50.125, 145.025, and 146.550. No repeater QSOs. Awards logs by June 30th to *Oregon QSO Party, c/o C.O.D.X.C. K7ZZZ, 19821 Ponderosa St., Bend OR 97702 USA.* Please contact this address for rules and enclose an SASE.

MAY 16–17

OAKHURST, NJ The Ocean-Monmouth ARC will celebrate a Marconi special event at one of the original antenna sites used by Marconi. Station N2MO will operate 1400 UTC May 16th–1400 UTC May 17th, on 80–10 meters in the General portion of the bands in SSB and CW. QSL with SASE to *OMARC, P.O. Box 267, Oakhurst NJ 07755 USA.*

MAY 23

HUNTSVILLE, TX The Sam Houston Radio Society will operate Club Station W5SAM from 1300 UTC–2200 UTC Saturday May 23rd, from the site of the statue of Sam Houston, beside Interstate 45 at Huntsville TX. The statue is visible for five miles and is the world's tallest statue of an American hero. Operation will be on or near 14.240, 21.300, and 28.495. For a special QSL, send QSL and business-size SASE to *Sam Houston Radio Society, 407 Elkins Lake, Huntsville TX 77340 USA.*

SUMTER, SC The Sumter ARA, in conjunction with the 55th Iris Festival in Sumter, will operate Special Event Station W4GL, 0400, Saturday, May 23rd–1600 UTC Sunday, May 24th. Stations contacted may request a certificate by sending a 9" x 11" manila envelope to the *Sumter Amateur Radio Assn., P.O. Box 193, Sumter SC 29151-0193 USA.* Contact person is *Steve Heriot KC4ZLB, (803) 773-2282.* W4GL will operate in the General portion of the amateur radio HF spectrum.

MAY 25

CANFIELD, OH The 20/9 ARC will celebrate Canfield OH's Bicentennial on Memorial Day, May 25th, by operating station K8TKA from the War Veteran Museum in Canfield. Operation will be 1300 UTC–2200 UTC. 40 meter phone on 7.260 ±5; 20 meter phone on 14.275 ±5. For a certificate, QSL with an SASE to *K8TKA, 2895 Penny Ln., Youngstown OH 44515 USA.*

JUNE 6–7

BOWLING GREEN, KY The Western Kentucky DX Assn. will operate KB4ALC from 0001 UTC June 6th–2359 UTC June 7th, in celebration of the annual Corvette Homecoming in Bowling Green. Frequencies: 7280, 14280, 21380, and 28480. Stations contacted may request a certificate by sending a QSL to *Kenneth E. Newman KB4ALC, 505 Emmett Dr., Bowling Green KY 42101.* 73

If you're a No-Code Tech, and you're having fun operating, tell us about it! Other No-Code Techs will enjoy reading about your adventures in ham radio—and we'll pay you for your articles. Yes, lots of nice clear photos, please. Who knows, you may even see one of your photos on a cover of *73 Magazine*! Call Joyce Sawtelle at 800-274-7373 to get a copy of "How to Write for *73 Magazine*." Then, send your stuff to *73 Magazine*, Attention: Joyce, 70 Route 202 North, Peterborough, NH 03458.

PROPAGATION

Jim Gray W1XU
210 E Chateau
Payson AZ 85541
[jimpeg@netzone.com]

May might not be a very exciting month for DX propagation, because of the approaching summer solstice, although there may be some days very favorable for sporadic E propagation.

The four days surrounding the 11th, as well as being poor for propagation, may produce violent geophysical effects such as volcanic activity, earthquakes, and severe windstorms.

10–12 meters

You may expect occasional short-skip openings from about 500 to 1500 miles. There may be rare openings to greater distances, but not regularly.

15–17 meters

You can expect some reasonable short-skip propagation out to 1500 miles or so, and occasionally greater distances, particularly transequatorial DX skip—with sometimes surprising signal strengths.

20–30 meters

As almost always, 20 meters will be your best DX band for both daytime and evening periods. Twenty will stay open until well after dark, and 30 meters really begins to shine in the late evening hours. Peak conditions exist shortly after sunrise at your location, and again in the late afternoon. Midday conditions are not likely to be good due to excessive ionization and absorption. Short skip will be excellent out to about 2500 miles on both bands on the best days.

40–80 meters

Forty will be excellent after dark unless the noise levels from thunderstorm activity are excessive. These will be "all night" bands, with 40 slightly better than 30, except for noise. Daytime short skip will average 1000 miles or more and nighttime short skip will average 1500 miles or more—usually more.

80–160 meters

These two bands are not known for summertime DX, and May is close enough to summer to be a problem because of high noise (QRN) levels. However, on quiet evenings you may find superb DX across the Atlantic on 80 meters for US and European hams. One-sixty is always a summertime problem, but using Beverage antennas

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MAY 1998

SUN	MON	TUE	WED	THU	FRI	SAT
					1 F-G	2 G
3 G	4 G	5 G-F	6 F	7 F-P	8 P	9 P
10 P-VP	11 VP	12 VP-P	13 P-F	14 F	15 F-G	16 G-F
17 F	18 F-G	19 G-F	20 F	21 F	22 F-G	23 G
24 G-F	25 F	26 F-G	27 G	28 G-F	29 F-P	30 P
31 P						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

"Harold...did you ever notice when you look up at the clouds...it looks like the tower is falling over?"

Number 88 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the August 1998 classified ad section is June 10th, 1998.

TELEGRAPH KEYS AT DAYTON HAMFEST: 500+ Pre-Civil-War-WWII Historic Antique Telegraph Keys. Bring your OLD keys, photos, stories. Free Information, History, Appraisals, Pretzels! Collectors' Show-'n'-Tell Parties, 4 p.m. I'll be Buying, Trading, Selling. Look for the 10-ft. KEY sign. Visit my Internet TELEGRAPH MUSEUM for previews and hamfest location. **[http://w1tp.com].** BNB42

WANTED: Old Altair, SOL or Imsai computer. Also software, drives and S-100 boards. **Bob Wood**, 3612 North 12th Ave., Pensacola FL 32503. (850) 432-3782. BNB52

RF TRANSISTORS TUBES 2SC2879, 2SC1971, 2SC1972, MRF247, MRF455, MB8719, 2SC1307, 2SC2029, MRF454, 2SC3133, 4CX250B, 12DQ6, 6KG6A, etc. **WESTGATE**, 1-800-213-4563. BNB6000

MAHLON LOOMIS, INVENTOR OF RADIO, by Thomas Appleby (copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM N3RF**, SVANHOLM RESEARCH LABORATORIES, P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

CERTIFICATE commemorating world's first airline stewardess. WAØAUU, NØLIM, and other Tri-State ARC members operating from her home town in the General bands 0730–1930 CST 8-8+9 and 8-15+16. Front of certificate will be photo of Ellen and the Boeing 8080A she flew in. Due to printing cost send $2, a QSL card and an 8-1/2 x 11 SASE. QSL info on the air. **Ernie Martin WAØAUU**, 403 West 2nd St., Cresco IA 52136. BNB57

TIRED OF IRONING? PCB service. No $ setup, free scanning available. **FIRST PROTO**, 4201 University Drive, #102, Durham NC 27707. (919) 403-8243. BNB5005

METHOD TO LEARN MORSE CODE FAST AND WITHOUT HANGUPS Johan N3RF. Send $1.00 & SASE. SVANHOLM RESEARCH LABORATORIES, P.O. Box 81, Washington DC 20044 USA. BNB421

WANTED: RF Installation Technician—Future Vision, Inc. is seeking individuals to install wireless data communication systems throughout the US and Canada. Candidates should have experience installing antennas, transmission lines, grounding systems, and tower climbing. Microwave & spread spectrum experience is a plus! This position includes extensive travel. Please forward résumé and salary requirements to Jim Hong KA8ZGP at [jim@futurevision.net] or by mail: **Future Vision, Inc.**, 1709 N. West Ave., Suite 117, Jackson MI 49202. Future Vision, Inc. is an equal opportunity employer. [www.futurevision. net]. BNB836

BIOELECTRIFIER™ 5 Hz micro current supply for plant and animal research. Semi-Kit $38.00. Assembled complete with batteries and silver electrodes $89.50. Add $2.50 postage. **Thomas Miller**, 314 South 9th Street, Richmond IN 47374. BNB343

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone:** (616) 925-5899, 8–4 ET. BNB964

CLASSIC RADIOS. RadioFinder Web list revised weekly: [www. radiofinder.com] Tel/FAX (313) 454-1890, [finder@radiofinder.com]. BNB700

AMERITRON AL-80A. Good Condx. 160–15 m. $500. Ship stateside only. **K9MKN**. (219) 658-4019 after 6 p.m. BNB59

COLLOIDAL SILVER GENERATOR! Why buy a "box of batteries" for hundreds of dollars? Current regulated, AC powered, fully assembled with #12 AWG silver electrodes, $74.50. Same, but DC powered, $54.50. Add $2.50 shipping. **Thomas Miller**, 314 South 9th Street, Richmond IN 47374. BNB342

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HIGH END SUBWOOFER AMPS, ALUMINUM CONES, OTHER AUDIO STUFF. Burnett Associates. **(603) 924-2383**. FAX (603) 924-3392. [FDTF77B@prodigy.com]. BNB999

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Propagation

continued from page 87

for receiving and vertical antennas for transmitting will give better than average results.

Gray-line DX

Always be aware that a half hour before and after local sunset often provides some really fine DX along the paths of darkness on all bands. Use it to your advantage.

Note about chart: The indicated band is only a guide. Always check the next higher or lower band. Where 10 meters is shown, listen on 12; where 15 meters is indicated, listen on 12 and 17; and so forth. 73

The New Approach to HF Radio!

The Kachina 505DSP Computer Controlled Transceiver

- Works with any Computer Running Windows 3.1, 95 or NT
- Covers all Amateur HF Bands plus General Coverage Receiver
- IF Stage 16/24 Bit Digital Signal Processing (DSP)
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- Band Activity Display with "Point and Click" Frequency Tuning
- On-screen Antenna "Smith" Chart, Logging Software and Help Menus
- Automatic Frequency Calibration from WWV or Other External Standard
- "Snapshot" Keys for Instant Recall of Frequencies and Settings
- Optional Internal Antenna Tuner

After twenty years of building commercial transceivers in Arizona, Kachina has decided the time is right for a new approach to amateur radio. The Kachina 505DSP is nothing short of a revolution in HF transceivers.

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In addition to 100% computer control, the Kachina 505DSP offers exceptional 16/24 bit DSP/DDS performance. IF stage DSP, "brick-wall" digital filtering, adaptive notch filters and digital noise reduction, combined with low in-band IMD and high signal-to-noise ratio, produce an excellent sounding receiver. Sophisticated DSP technology achieves performance levels unimaginable in the analog world. The transmitter also benefits from precise 16/24 bit processing. Excellent carrier and opposite-sideband suppression is obtained using superior phasing-method algorithms. The RF compressor will add *lots* of punch to your transmitted signal without adding lots of bandwidth, and the TX equalizer will allow you to tailor your transmitted audio for more highs or lows.

American-made and designed, and able to stand on its own against the world's best, the 505DSP is bound to set the standard for all that follow. But don't take our word for it. Visit our website at http://www.kachina-az.com for detailed specifications, to download a demo version of our control software, or to see a current list of Kachina dealers displaying demonstration models in their showrooms.

KACHINA COMMUNICATIONS, INC.

JRC

JST-245

160-10 Meters PLUS 6 Meter Transceiver

Fifteen reasons why your next HF transceiver should be a JST-245. . .

1 All-Mode Operation (SSB,CW,AM,AFSK,FM) on all HF amateur bands and 6 meters. JST-145, same as JST-245 but without 6 meters and built-in antenna tuner.

★ JST-145 COMING SOON ★

2 MOSFET POWER AMPLIFIER • Final PA utilizes RF MOSFETs to achieve low distortion and high durability. Rated output is 10 to 150 watts on all bands including 6 meters.

3 AUTOMATIC ANTENNA TUNER • Auto tuner included as standard equipment. Tuner settings are automatically stored in memory for fast QSY.

4 MULTIPLE ANTENNA SELECTION • Three antenna connections are user selectable from front panel. Antenna selection can be stored in memory.

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8 NOTCH TRACKING • Once tuned, the IF notch filter will track the offending heterodyne (±10 Khz) if the VFO frequency is changed.

9 DDS PHASE LOCK LOOP SYSTEM • A single-crystal Direct Digital Synthesis system is utilized for very low phase noise.

10 CW FEATURES • Full break-in operation, variable CW pitch. built in electronic keyer up to 60 wpm.

11 DUAL VFOs • Two separate VFOs for split-frequency operation. Memory registers store most recent VFO frequency, mode, bandwidth and other important parameters for each band.

12 200 MEMORIES • Memory capacity of 200 channels, each of which store frequency, mode, AGC and bandwidth.

13 COMPUTER INTERFACE • Built-in RS-232C interface for advanced computer applications.

14 ERGONOMIC LAYOUT • Front panel features easy to read color LCD display and thoughtful placement of controls for ease of operation.

15 HEAVY-DUTY POWER SUPPLY • Built-in switching power supply with "silent" cooling system designed for continuous transmission at maximim output.

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